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New England Editor
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Pacific Coast Editor
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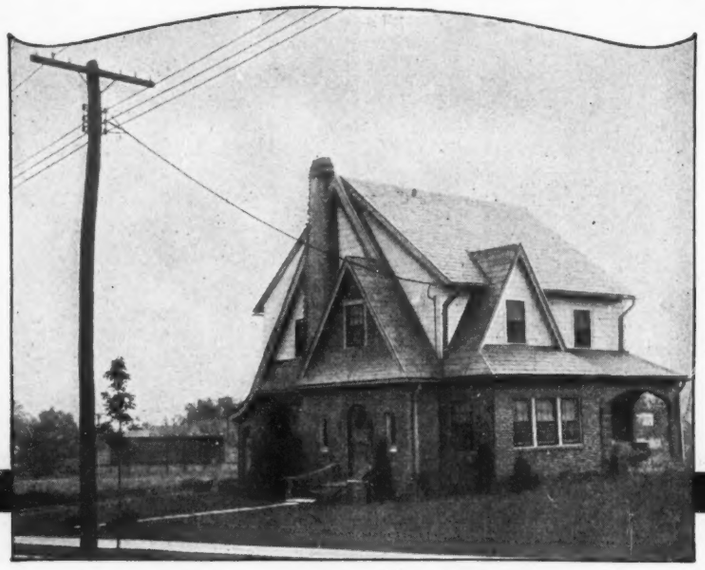

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ELECTRICAL WORLD

for the Week Ending

July 5, 1930

A.I.E.E. holds Toronto convention

0.7 lb. per kw.-hr. with mercury unit

Hardware men oppose utility sales

Jadwin to Head Power Commission

—MERCURY-VAPOR unit at Hartford passes experimental stages. Utilized in regular operation, this equipment has produced 40,000,000 kw.-hr. on basis of 0.7 lb. of coal or 10,000 B.t.u. per kilowatt-hour.

—MERCHANDISING by utilities arouses ire of National Retail Hardware Association. St. Louis convention directs petitioning of state commissions to halt alleged unfair practices in cut rates on appliance sales.

—BAGNELL 210,000-hp. development on the Osage River, threatened by Camden County (Missouri) official action, is relieved of injunction threat. Appeal planned by local interests. Governor calls for state hydro law.

—ALASKA looms large in hydroelectric development as paper interests apply to Power Commission for eight plant privileges totaling 227,000 hp. One project would involve 8,500-ft. tunnel from lake to power house.

—INTERSTATE transmission of energy again to the fore. N.E.L.A. claims 11.8 per cent, while Federal Trade Commission holds out for something nearer 16 per cent.

—CHANGEOVER from 30- to 60-cycle operation in Consumers Power Company's western division, Michigan, began last month. A $6,000,000 job, it will require four years to complete.

—RATIONALIZATION of insulation values dominates Toronto convention of American Institute of Electrical Engineers. Lightning arresters no longer to assume the major burden of performance, it seems.

NEWS OF THE WEEK

Hoover to Name Jadwin to Head Power Commission

SELECTION of Lieutenant-General Edgar Jadwin, former chief of engineers of the United States Army, for chairman of the reorganized Federal Power Commission was announced by President Hoover on Tuesday of this week. Since the enactment of the water-power act in 1920 General Jadwin has been in close touch with the engineering phases of the work of the commission. As assistant chief of engineers he was in immediate charge of the engineering reports made on projects on navigable streams outside the forest reserves.

As chief of engineers General Jadwin was the author of the plan for the control of floods on the Mississippi River. While some phases of the plan have been criticised, there is very general agreement that the development of so complete a plan in the short time allowed for that purpose was a very real engineering accomplishment. While chief of engineers General Jadwin also was chairman of the National Capital Park and Planning Commission and the author of the minority report from that body urging the development of the water-power resources of the Potomac in the Washington area. Congress has passed the Cramton bill, designed to establish a public park on the site of the Great Falls of the Potomac, but, as reported last week, the Senate defeated an appropriation of $1,000,000 to begin work.

It is anticipated that some objection will be raised to General Jadwin when his name comes before the Senate for confirmation. His recommendations in connection with Cumberland Falls and several other projects were not popular with those members of the Senate who are active critics of the power-producing companies. His nomination will not be sent to the Senate until the President shall have decided upon the other commissioners he will nominate. All of the nominations will be sent to the Senate after the convening of the special session to follow the regular one.

Niagara-Hudson Merger of Mohawk Is Postponed

BY THE withdrawal on July 1 of the application of the Niagara-Hudson Power Corporation to the New York Public Service Commission for permission to hold the stock of the operating subsidiaries of the Mohawk-Hudson Power Corporation the contemplated consolidation of the Niagara-Hudson and the Mohawk-Hudson under the former title is postponed.

Randall J. Le Boeuf, Jr., chief counsel of the Niagara-Hudson, explained that by the withdrawal of the application it was hoped to expedite the ultimate plan of unification. Rulings of the Treasury Department at Washington indicating a substantial claim for taxes caused the withdrawal, he said, adding: "It has been deemed wiser to attempt to secure a sufficient portion of the preferred stock of the Mohawk-Hudson so that, in addition to the large holdings of common stock, Niagara-Hudson will own not less than 95 per cent of all Mohawk-Hudson stock."

The operating companies concerned are the Cortland County Traction Company, Eastern New York Utilities Corporation, New York Power & Light Corporation, Utica Gas & Electric Company and Syracuse Lighting Company.

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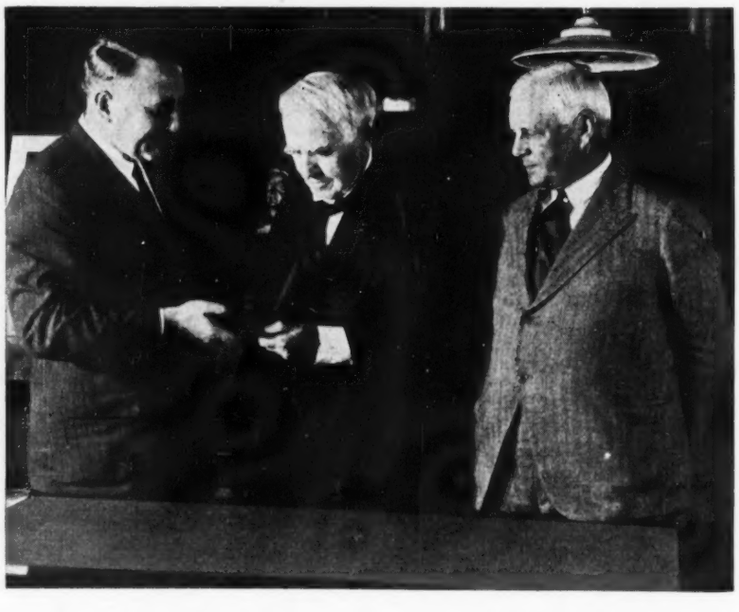
ARGENTINA SENDS MEDAL TO EDISON



A gold medal from the electrical engineers and scientists of Argentina was presented to Thomas A. Edison recently at his New Jersey laboratory in commemoration of the fiftieth anniversary of his incandescent lamp by William A. Reece of Buenos Aires, president of General Electric, S.A., of Argentina. C. C. Chesney (right), a past-president of the A.I.E.E., presided at the presentation

Attempt to Enjoin Big Missouri Dam Fails

INJUNCTION sought against the Union Electric Light & Power Company of St. Louis to prevent it from continuing with the construction of its great hydro-electric dam and power plant on the Osage River near Bagnell, Mo., was refused in the United States court at Kansas City on June 19.

The court found that both the Osage and the Niangua River are navigable and that the dam, instead of impairing navigation, would improve it. It also held that the water-power act is applicable since the dam is on a navigable stream and that the property needed for the improvement could be taken under the right of eminent domain. Camden County officials plan to appeal to the United States Supreme Court.

Governor Henry C. Caulfield of Missouri has announced that he will ask the 1931 General Assembly of that state to enact legislation to establish state control over such of Missouri's water-power resources as have not already passed to private interests under federal water-power permits.

▼

Boulder Clause Passes— Hurley Answers Critics

FOLLOWING nine years of debate Congress has at last removed all of the obstacles in the path of commencement of construction of the Boulder Dam project. Over the protest of the Arizona Senators, the Senate on June 27 approved the item in the second deficiency bill providing an appropriation of $10,660,000 for starting the work. The House already has indorsed the bill and the Boulder Dam appropriation. Barring court interference, there is nothing now that can prevent the project from being carried to completion.

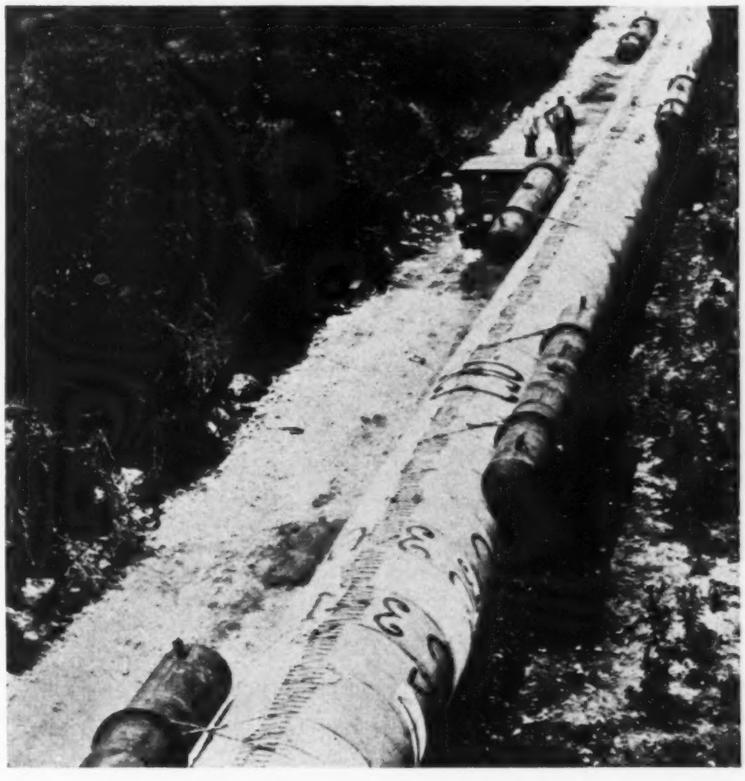
Senator Ashurst made an attack on the validity of the contracts for the disposal of part of the power to the Los Angeles Bureau of Power and Light. He expressed the opinion that the taxpayers of Los Angeles are not bound by this contract and cannot be bound to stand behind the Bureau of Power and Light in case the terms of the agreement are not carried out. Senator Hayden questioned the advisability of appropriating money for the construction of the dam when the plans for the design of the structure are not complete. He favored a smaller appropriation to be used for further engineering studies and surveys. The sentiment was expressed in the course of the discussion that the dam should be of ultra-conservative design since the destruction that would be brought about by its failure would be so great.

After the Senate had passed the Black resolution directing the Secretary of War to sell power from the Wilson Dam to municipalities, a telegram was sent by the War Department to the city of Florence, Ala., stating that the best interests of the government are served by continuing the present agreement with the Alabama Power Company. Senator Black addressed the Senate on June 28, taking exception to the War Department's policy. He said that the agreement between the government and the Alabama Power Company contains no stipulation that would prevent the sale of power to others. Other Senators engaged in the debate and expressed interest in Senator Black's contention that a large part of the firm or minimum power is now going to waste. As the result of the discussion, a resolution was agreed to directing the Secretary of War to furnish the Senate with the written agreement entered into with the Alabama Power Company for the exclusive use of the power.

A second resolution authorizing the Secretary of War to sell Wilson Dam power to municipalities was introduced by Senator Norris of Nebraska on Monday and referred to committee. It was thought unlikely that it could be jammed through Congress in the closing hours of the session. In the House Representative Almon of Alabama charged that the "power trust" was responsible for the Secretary's attitude.

In reply to his critics, Secretary of War Hurley asserted that mechanical difficulties rather than matters of policy are mainly responsible for the War Department's attitude toward the sale of electrical energy to municipalities. Mr. Hurley said that pending the passage of legislation by Congress it has been the policy of the War Department to obtain as large a revenue as possible from the sale of power. He believes that a greater revenue can be obtained through an exclusive contract with the Alabama Power Company than by any other means, since the Alabama Power Company is in possession of the only transmission and distribution system of magnitude in the vicinity of the Muscle Shoals plant. The government plant could not be put in shape for the sale of scattered small amounts of power, the Secretary adds, without subjecting the taxpayers to an unjustifiable expense.

CLAUDE TUBE ON THE WAY TO ITS FATE



Last week's news (page 1316) told of the loss of the great power tube—5,900 ft. long and 6 ft. in diameter—designed by Georges Claude, French inventor and scientist, as it was being installed in Matanzas Bay, Cuba. Undaunted by this, the second failure, the inventor says another tube will be ready in August.

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Large Hydro Projects in Alaska Ask Licenses

INITIATION of a great industry in Alaska is seen in the applications to the Federal Power Commission for licenses covering large developments of power in connection with the establishment of a pulp and paper mill. The applicants are George T. Cameron of San Francisco (with whom is associated Harry Chandler of the Los Angeles *Times*) and the Zellerbach Corporation. Each of these applicants is planning to develop power sufficient to operate plants with a daily output of 500 tons. In each instance, however, the immediate installation will be for 250 tons daily.

The Cameron development consists of a tunnel 8,500 feet long, extending from Long Lake to a power house on the shore of Speel Inlet, and a tunnel 6,300 feet long from Crater Lake to the same power house. A third tunnel will connect another power house with Dorothy Lake. The estimated capacity at the Speel Inlet power house is 35,935 hp. At the other power house the capacity will be 24,335 hp. It is proposed to install equipment sufficient to generate 87,000 hp.

The power house for the Zellerbach plant will be developed at the outlet of six lakes known as Mirror, Ella, Manzanita, Swan, Grace and Orchard. There are to be five power houses with a total installation of 80,000 hp. The primary power to be made available is 47,000 hp.

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Abandon Municipal Ownership by 25 to 1

BY AN overwhelming majority—492 votes against 20—citizens of Marlinton, West Va., have voted to approve the sale by the City Council of the municipally owned electric light plant to the West Virginia Public Service Company, a subsidiary of the Monongahela-West Penn Public Service Company. The price agreed upon for the plant is $65,000.

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A. E. R. A. Holds Annual Meeting at San Francisco

NEARLY 1,500 delegates were in attendance at the forty-ninth annual convention of the American Electric Railway Association, held in San Francisco June 23 to 26, and participated in meetings of the American and affiliated associations. Confidence in the future of electric railways was expressed by Paul Shoup in his presidential address. Presentation of the Coffin award for 1930 was made to the Youngstown (Ohio) Municipal Railway.

The principal speaker at Monday's banquet was A. W. Robertson, chairman of the board, Westinghouse Electric & Manufacturing Company. Among other important addresses was one by John E. Curtiss, chairman Nebraska State Railway Commission, on the subject of the public responsibility in regulating competitive industry. J. H. Hanna, president Capital Traction Company, Washington, D. C., was elected president of the association for the coming term.

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Coal Surcharge Discussed in Boston and New York

EXCEPT for final arguments, which will be made on a date to be set later, the inquiry into the rates of the Edison Electric Illuminating Company of Boston before the State Department of Public Utilities was completed on June 25. The inquiry, based on petitions by the city of Boston and a group of outside consumers, has been in progress at the State House intermittently over a period of months. Allocation of costs, especially with relation to coal, figured prominently in the inquiry. Lynn S. Goodman, assistant superintendent of the statistical department of the Edison company, testified that revenue from the coal charge by the company in 1929 amounted to $480,588. Mr. Goodman said that the number of customers paying a coal-rate charge has been reduced since then.

New Yorkers protesting against the coal surcharges past and present of the associated Edison companies in the metropolitan district have issued a "preliminary presentation as to facts," in which they take issue with the companies' stand as presented by President Sloan (ELECTRICAL WORLD, April 5, page 676). The petitioners ask that an order be issued by the Public Service

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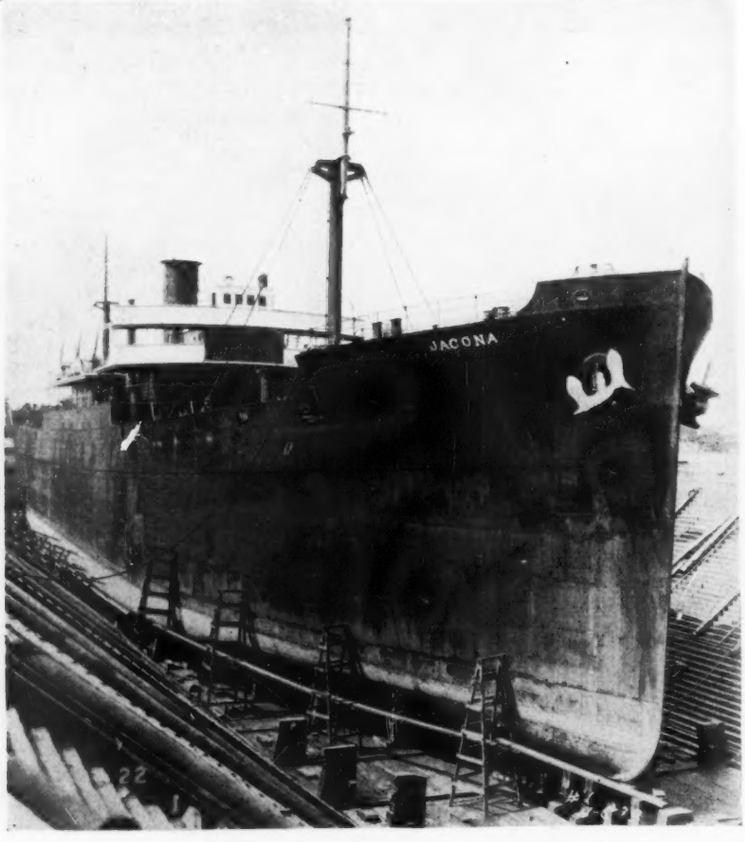
NEW ENGLAND'S FLOATING POWER PLANT



The "Jacona," a 7,668-ton ship purchased for $25,000 from the United States government, is in drydock at Newport News, Va., being converted into a floating power plant for use in the coastal districts of companies in the New England Public Service group. It will have a generating capacity of 20,000 kw. in two G.E. units

Commission suspending the effectiveness of the coal surcharges immediately and that this order stipulate that their re-establishment be dependent upon the decision rendered in the case now at issue. The petitioners request further that the commission's engineering and legal forces be placed at their disposal "as the results in this case will affect every consumer of electricity served by the defendant companies."

▼

Grigsby-Grunow Sues Radio Corporation et al.

SUIT was filed on June 26 in the United States District Court in Kansas City by the Grigsby-Grunow Company of Chicago to recover triple damages, amounting to $30,000,000, from the Radio Corporation of America, the General Electric Company, the Westinghouse Electric & Manufacturing Company and others. The suit also charges these companies with violating the Sherman anti-trust law.

Among the charges filed by the Grigsby-Grunow Company are that the defendants illegally created a vast pool of patents and thus illegally compelled the payment of royalties in the sum of almost $6,000,000 from the Grigsby-Grunow Company. The petition further charges that under the "tube clause" contained in the license agreement which the Grigsby-Grunow Company received from the defendants the independent company was compelled to buy radio vacuum tubes from the Radio Corporation at a high price and was prevented from engaging in the vacuum-tube business until after this clause was declared illegal by the United States District Court of Delaware.

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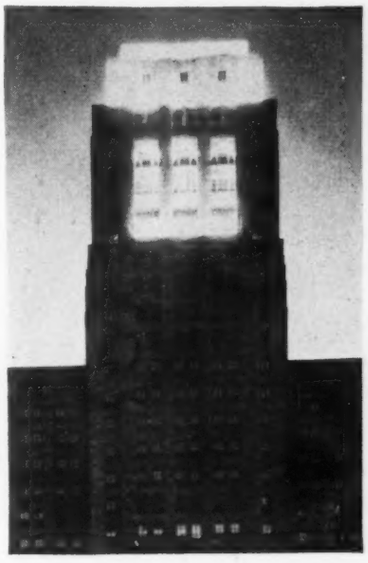
Consumers Power Starts Work to Unify Frequencies

EMBARKATION in June upon the actual work of changing the frequency of its entire Western Division from 30 cycles to 60 cycles has been announced by the Consumers Power Company of Jackson, Mich., which more than a year ago made public its decision to standardize the frequencies on this division and began studies.

The company's western division includes about one-third of the system and is centered in Grand Rapids. Thirty-cycle operation was adopted about 25 years ago, when it was operated as a detached and independent unit. It has worked well, and the principal motive dictating the change is the endeavor to improve relations with customers by eliminating the need to use non-standard motors and other devices. Another important factor is the possibility of obtaining a greater number of desirable motor speeds.

The program of change-over, which is expected to cover about four years and to cost more than $6,000,000, exclusive of alterations in stations and transmission lines, is made up of four steps—first, changes in generating and transmission-line equipment; second, changes in distribution circuits; third, changes in customers' meters; fourth—and largest—replacement of customers' apparatus with the minimum of interruption. In general there will be no cost to the consumer. All the work will be done by the Consumers Power Company and the Allied Engineers, Inc.

ALBANY BUILDING A BEACON BY NIGHT



At sunset the 57,000 watts of floodlighting equipment on the new 33-story state office building in Albany, N. Y., are turned on. From 11 p.m. to dawn the 22,000-watt installation on the thirty-third floor remains in operation

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Hardware Men Oppose Utilities as Merchants

THE National Retail Hardware Association, in convention at St. Louis, passed a resolution on June 26 directing that petitions be sent to the various state public service commissions asking that the practice of certain public utilities in selling electric and gas appliances at excessively low prices and absorbing the resultant loss in the general expense account on which their general rates to customers are based be abated.

The hardware men charged that certain public utilities fix prices on appliances that are not compatible with expense of selling, of installation and of the low-term credit plans under which the sales are made. They allege that this unfair practice has resulted in the loss of considerable appliance business to hardware men.

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Pennsylvania Railroad Arranges for Energy

OFFICERS of the Public Service Electric & Gas Company announced at Newark, N. J., on June 26 that arrangements have been made with the Pennsylvania Railroad Company whereby the Philadelphia Electric Company and the Public Service Electric & Gas will co-operate in supplying power for the operation of the electrified section of the Pennsylvania Railroad between New York and the Delaware River.

The Pennsylvania electrification, of which this is a part, is to be one of the most extensive and important in the United States from the standpoint of frequency and amount of traffic. Dependability and continuity of power supply will be insured through thus using the resources of two of the country's great electric systems. These two power systems are already interconnected, and when the additional interconnections under way shall be completed in the near future one of the largest power pools in the world will be formed.

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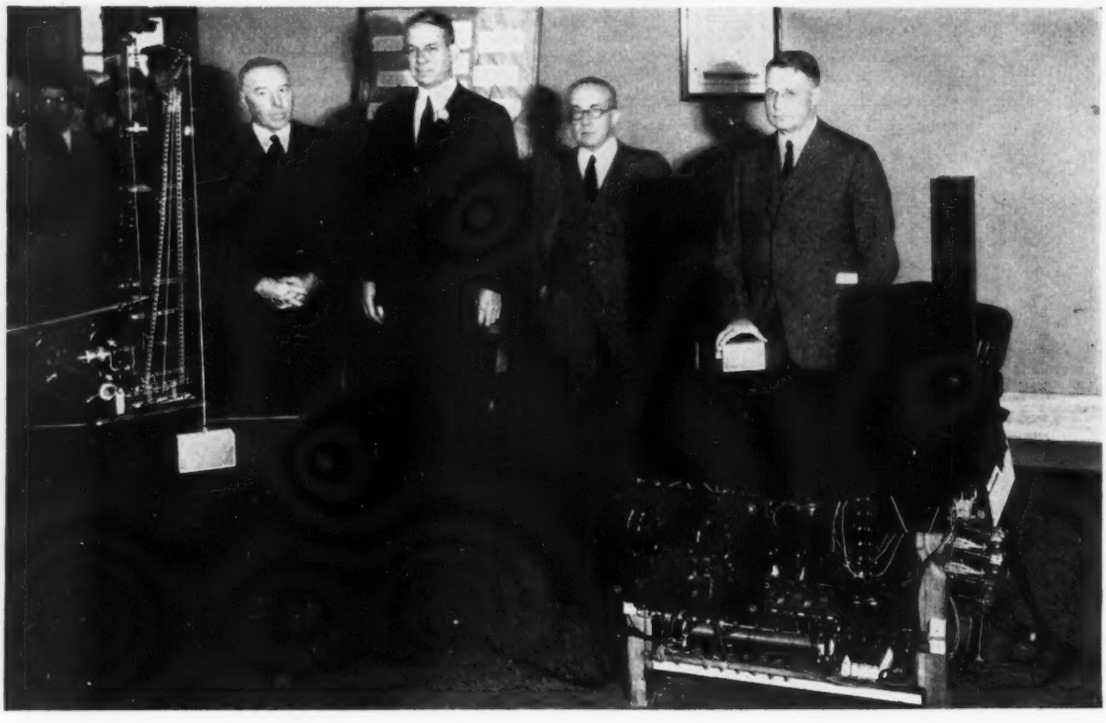
Electrification Hailed and Renewed Prosperity Seen

DEDICATION on June 28 of Cleveland's new Union Terminal, with its 17-mile electrified right-of-way and approaches from Collinwood, on the east of the city, to Linndale, on the west, and its 22 electric locomotives to haul trains in and out, brought from the 3,000 business leaders present at a luncheon both enthusiastic approval of the revolution in local traffic thus brought about and indorsement of optimistic business prediction by speakers.

Chief among the latter was P. E. Crowley, president of the New York Central Lines, who expressed the belief, which he said was shared by his fellow railway executives, that the slack-business corner had been turned and that the country will go forward to as great prosperity as it ever has attained.

WESTINGHOUSE CORNERSTONE LAID BY ELECTRICAL PROXY



While a drenching rain washed the location where the cornerstone of the new $2,000,000 Westinghouse engineering laboratory in East Pittsburgh, Pa., was to be set recently, officials, dry and comfortable in an office building, conducted the ceremony and placed the stone. As shown, W. S. Rugg is putting a model block in position. The apparatus at the left serves to depict the actual laying as it simultaneously occurred out of doors. Photo-electric cells operated by movements of the model stone supply the necessary impulses to power circuits. Westinghouse officials participating are (left to right) S. M. Kintner, A. W. Robertson, F. A. Merrick and W. S. Rugg

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Power Production Occupies the A. S. M. E.

BEHAVIOR of metals at elevated temperatures, with special reference to embrittlement and crystalline rearrangement, and the performance of steam boilers with gas firing and oil firing and with the two forms of pulverized-fuel combustion were the two most important subjects directly related to electrical production discussed at the convention of the American Society of Mechanical Engineers in Detroit, June 9 to 12. The subject first named received lively discussion on account of its direct bearing on recent developments along the line of power-station steam temperatures above the now commonly accepted total heat of approximately 700 deg. F.

Flow characteristics of certain steels and of special iron-nickel-chromium alloys at high temperatures were treated in a paper by H. J. French, William Kahlbaum and A. A. Peterson. An apparatus for the determination of metal creep at elevated temperatures was described by A. E. White, C. L. Clark and L. Thomassen, and Professor White was again represented with R. Schneidewind in another paper dealing with fractures in boiler metal.

Comparative performance of bin and unit systems of firing pulverized fuel and similar comparative data on oil and gas firing by A. E. Grunert and F. G. Philo were the subjects respectively of two papers that received much attention. Several other papers directly related to steam-power-plant operation.

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Economic Council to View New York Public Affairs

GROWING out of the former Committee of Twenty-five, New York State-Wide Economic Congress, the New York State Economic Council has just been established. Broadly speaking, it will conduct surveys and studies in the effort to accomplish for the Empire State results similar to those achieved by the New England Council in the last five years. The New York body will take a keen interest in legislative activities, taxation, public expenditures and all factors connected with industrial development throughout the commonwealth.

Merwin K. Hart of Utica is chairman of the council, Elon H. Hooker vice-chairman, James W. Gerard treasurer, and Robert S. Binkerd is chairman of the executive committee, which has seven other prominent business men as members. Twelve men compose the board of directors, among them Magnus W. Alexander, John N. Carlisle, H. T. Dyett, W. L. Hinds, James H. McGraw and Charles S. Ruffner. A special committee of nine to consider public expenditure in all aspects will be headed by William A. Prendergast, formerly chairman of the New York Public Service Commission.

Mr. Hart, speaking on June 23 at Glens Falls, N. Y., contrasted the part played by politics and by economics in public affairs, with particular reference to the St. Lawrence River development situation as it now exists in New York.

Construction Work in Many Regions—Planned, Under Way or Finished

DESPITE business depression, the construction of electrical plants and transmission systems is going on energetically in every part of the country, and plans for new construction are being pushed. Information of this nature, covering work just completed, under way or in early contemplation, which has recently come unsolicited to the ELECTRICAL WORLD from utility offices or news contributors, is condensed below by states. It is, of course, far from a complete record. Some of the items bring previous ones up to date; others record projects not hitherto noted in these columns.

Arkansas The long-contemplated development of the White River in Arkansas has reached another stage with the publication of plans for three dams—one across that river proper, one across its tributary, the Buffalo, and one across the North Fork of the White River. Application to the Federal Power Commission by the White River Power Company, of which H. C. Couch is president, indicates a development of more than 300,000 hp. and an ultimate investment of $45,000,000. Seven years would probably be required for construction.

The dam in White River will be 225 ft. high and the power house at that point will have an installed capacity of 270,000 hp. The dam in Buffalo Creek will be 145 ft. high and 27,000 hp. will be installed. The dam in the North Fork will be 175 ft. high and the power house at that point will have an installation of 7,500 hp.

This development, with the Bagnell project on the Osage River in Missouri and the one at Table Rock on the White River, will put the Central South very much on the water-power map. Work is expected to go forward rapidly on these three large projects.

Colorado The Public Service Company of Colorado, Denver, will begin construction immediately on a 100-kv. transmission system connecting Denver with the company's Valmont steam generating plant near Boulder, Colo. Upward of half a million dollars is to be spent on the system. Wooden-frame construction is to be used.

Indiana New details of the development program of the Indianapolis Power & Light Company have just been made public. The Harding Street power station will require more than $9,000,000, and a high-tension tower transmission line circling Indianapolis beyond its present boundaries will require $1,737,487, including three substations to be erected immediately as a part of the transmission system. Present plans call for the completion of the Harding Street station early in 1931. Contracts have been signed with the Westinghouse Electric & Manufacturing Company for two 35,000-kw. turbo-generators, and eight 1,200-hp. boilers are under construction. The transmission line outside the city will be between 40 and 50 miles long and will be erected on steel towers 80 ft. high.

Iowa Plans for an eighteen-million-dollar hydro-electric project on the Mississippi River 3 miles east of Muscatine, Iowa, have been made by the Federal Construction Company. They include a dam on the Cedar River, near Moscow, and a 7-mile canal to the Mississippi. The initial production capacity, according to the promoters, will be 138,000

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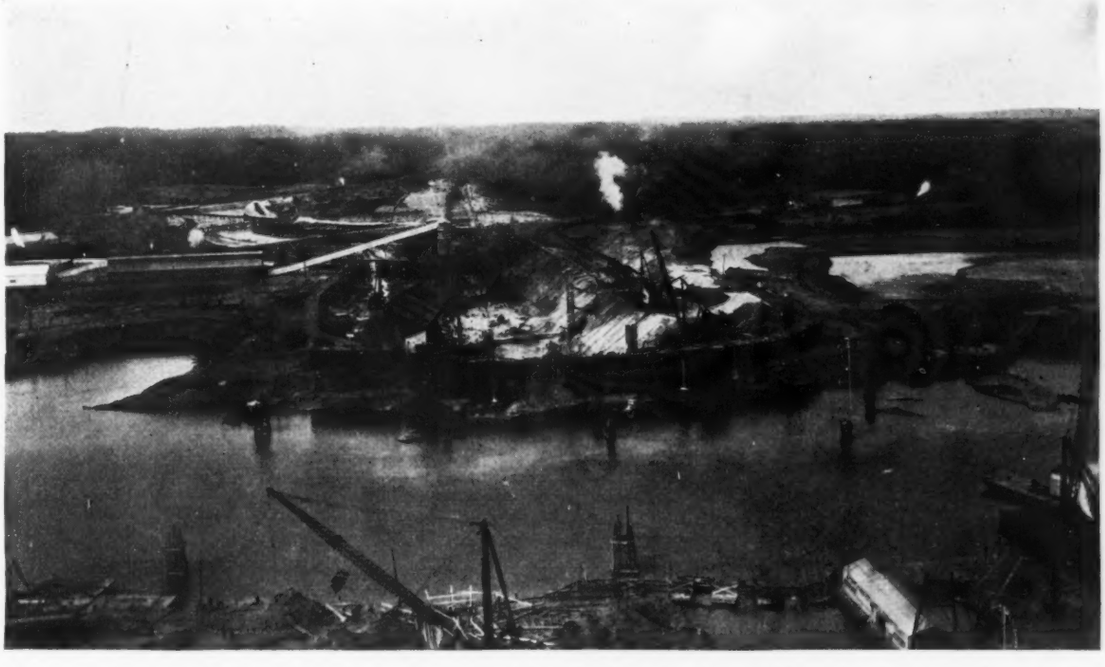
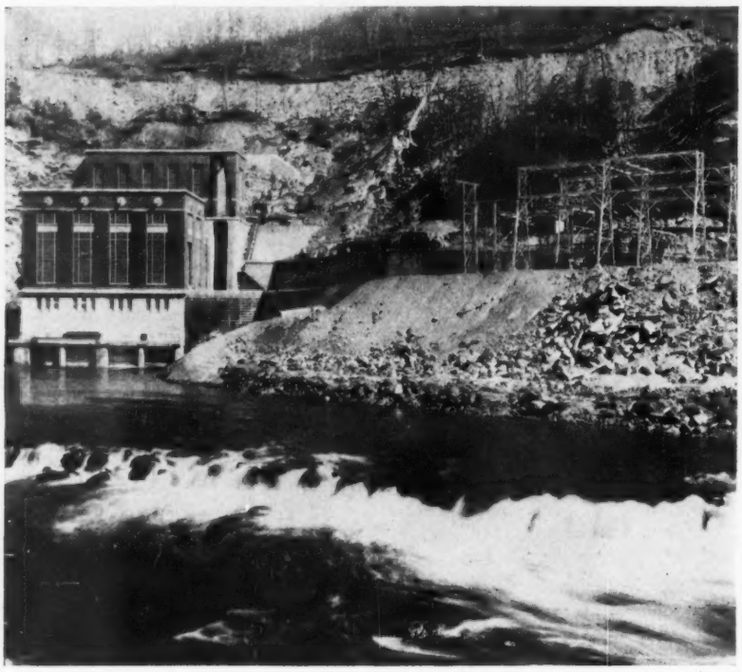
210,000-HP. OSAGE DEVELOPMENT PROGRESSING RAPIDLY



Although construction work was started only late last fall on the Osage River development of the Union Electric Light & Power Company at Bagnell, Mo., rapid progress is being made toward the formation of the "Lake of the Ozarks." Stone & Webster are handling the job

N. Y. POWER & LIGHT'S CONKLINGVILLE PLANT



Nestled in the Adirondack foothills, just below the great regulating dam, 1,200 ft. long and 115 ft. high, forming Sacandaga Reservoir, the 25,000-kva. (maximum capacity) Elmer J. West station of the New York Power & Light Corporation, named for a pioneer of power, was formally dedicated recently. The spillway section of the dam, running down stream at right angles to it, is approximately 800 ft. long and 50 ft. deep. The power station is connected to the lower end of this spillway section

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hp., rivaling that of the Keokuk power dam, and will later be increased. In previous years adverse engineering reports on this project have been made.

Minnesota Construction of the first unit of the Minnesota Power & Light Company's new steam-electric plant at Duluth has started. It will be rated at about 20,000 kw. and cost $3,500,000. Ultimate capacity of the plant is put at 200,000 kw.

Coming installation by the Northern States Power Company at the Riverside steam-electric station in Minneapolis of a 35,000-kw. turbine and auxiliary equipment and three new boilers to operate at 400 lb. pressure is announced. Work on the substructure will start November 1, and the project is scheduled for completion in the fall of 1931.

New York Generating capacity of the Niagara-Hudson system has been increased by 10,000 hp. through the completion of a hydro-electric station on the Salmon River at Lighthouse Hill, Oswego County, N. Y., which uses the water that first passes through the company's 35,000-hp. plant upstream. A concrete dam 600 ft. long and 60 ft. high has been built. Energy is transmitted to Syracuse and Watertown at 110 kv.

New Jersey The Eastern New Jersey Power Company will complete its new Raritan River power plant near Sayreville, N. J., by August 1. It will have initial capacity of 60,000 kw. in two 30,000-kw. units and an ultimate capacity of 180,000 kw.

Pennsyivania Work is well under way on the Safe Harbor Water Power Corporation's hydro development on the Susquehanna River, Pa., in which the Pennsylvania Water & Power Company and the Consolidated Gas, Electric Light & Power Company of Baltimore have substantial interests. The initial installation will consist of six main generating units with a turbine rating of 231,000 hp. Provision will be made in the foundations for at least six additional units, which are estimated to give a final capacity of approximately 500,000 hp. The new plant will be connected by high-tension transmission lines to Baltimore and Holtwood.

A 31,000-hp. hydro plant on the Allegheny River in Pennsylvania is planned by the West Penn Power Company, which has applied for a preliminary permit from the Federal Power Commission. It would be built in connection with Dam No. 8, being constructed by the United States government across the Allegheny between Templeton and Mosgrove, above Kittanning. The plan awaits the army engineers' report.

Tennessee Seventeen miles of steel-tower transmission line from the Hale's Bar plant to Valdeau, involving a 49,000-kw. transformer station; 18 miles from Hohenwald to Mount Pleasant, 22 miles from Murfreesboro to Franklin, 57 miles from Waynesboro to Lexington, and 25½ miles from Estill Springs to Fayetteville—all to be operated at 44 kv.—are under way for the Tennessee Electric Power Company, which spent for construction in the first five months of 1930 $5,100,000, as compared with $1,500,000 for the same period last year. The company's total estimate for the current year is approximately $8,000,000.

The Mountain Power Company of Chattanooga, Tenn., has applied to the Federal Power Commission for a preliminary permit covering a 55,000-hp. project on the Tellico River in Monroe County, Tenn. The proposed plan contemplates the development of the river from Tellico Plains upstream for a distance of 22 miles. There is to be a series of six dams at which power will be developed. In addition it may be decided to construct three additional dams for storage purposes.

Texas Approval has been given by the Dallas City Commission to a project of the Dallas Power & Light Company for formation of a lake at Mountain Creek and erection of a power plant to cost in all $8,587,541. It is recommended that the company before completion of the lake should apply to the city for authority to erect one-forth of the proposed buildings and install one unit of 30,000-kw. or 35,000-kw. capacity. An eventual rating of 120,000 kw. is planned.

Following its action in extending for a period of two years the permits granted to Emery, Peck & Rockwood of Chicago for the construction of six power dams and hydro-electric plants on the Colorado River, the State Board of Water Engineers will soon make a geological survey of the sites of the proposed dams and reservoirs. As soon as the survey is completed, the construction of the first two dams will be started. The entire project involves an expenditure of more than $15,000,000.

The Texas Hydro-Electric Corporation of Seguin has awarded the contract

for the construction of three additional power dams on the Guadalupe River at points between Seguin and Gonzales at a total cost of $900,000, or $300,000 for each dam.

The Central Power & Light Company has filed tentative plans to construct on the Pecos River the largest hydro-electric power plant in Texas, if its investigation proves the feasibility of the project. For 8 miles the Pecos River and the Rio Grande run parallel to each other half a mile apart. Their parallel course starts just above the point where the Pecos River empties into the Rio Grande. There is a difference of 73 ft. in the normal water levels of the two streams. It is proposed by the company to construct a dam 100 ft. high on the Pecos River and to build a tunnel through rock wall, separating the two streams. The hydro-electric plant would be located on the Rio Grande at the mouth of the tunnel.

Authority to issue $1,800,000 of bonds to supplement $4,800,000 previously sold is sought by the Maverick County Water Improvement District No. 1 of Eagle Pass in an application filed with the State Board of Water Engineers. The proceeds from the sale of the additional bonds will be used for the construction of a hydro-electric plant as a part of the irrigation project. The proposed plant will have an initial capacity of 12,000 hp. The power plant will be leased and operated by the Central Light & Power Company.

Within a short time the new power line of the Gulf Cities Utility Company from the Neches power plant near Beaumont, Tex., to Dayton, Tex., will be completed. It is 50 miles long.

Brief History of the "Electrical World"

The *Electrical World* (published under that name since 1883 and tracing its history back to 1874) is a consolidation of the *Electrical Engineer* (founded in 1882 as the *Electrician*) and the *American Electrician* (founded in 1896). Final consolidation under the title of *Electrical World* took effect on January 1, 1906, the *Electrical World* and the *Electrical Engineer* having been acquired by the McGraw Publishing Company in 1899 and amalgamated as the *Electrical World and Engineer*, and the *American Electrician*, a McGraw monthly, having been absorbed seven years later.

The roster of past editors of the *Electrical World* includes Carl Hering, Louis Bell, W. D. Weaver, T. C. Martin and many other men prominent in the electrical industry —some, like those named, no longer living, and others, like C. O. Mailloux, A. S. McAllister, Frank F. Fowle, F. M. Feiker, D. H. Braymer and H. V. Bozell, still active in engineering and industrial service. L. W. W. Morrow is now editor. Allen M. Perry is managing editor. Other members of the present staff are: Earl Whitehorne, contributing editor; G. F. Wittig, statistical editor; H. M. Cameron and A. E. Knowlton, associate editors; F. C. Wells, news editor; E. R. Searles and E. M. Glennon, assistant editors; F. R. Innes, Western editor; H. S. Knowlton, New England editor; Walter C. Heston, Pacific Coast editor, and Paul Wooton, Washington correspondent.

Washington Six and a half million dollars is to be spent in 1930 by the Puget Sound Power & Light Company on its Rock Island hydro-electric development, of which the total cost of initial construction will be $15,000,000. The completion of the second unit in the Shuffleton steam plant at Renton will cost $1,700,000, and miscellaneous construction expenses, including additions to the transmission system, $3,800,000—a total construction budget of $12,000,000.

An intense development is planned along the north bank of the Columbia River between Vancouver and Longview, Wash., which will bring the full utilization of the resources of the region. A chain of hydro-electric projects on the Lewis River, similar to the Ariel project now under construction, will be built, according to L. T. Merwin, vice-president and general manager of the Northwestern Electric Company. He said that $8,250,000 will be the cost of this first unit now being erected at Ariel, which will produce 53,000 hp., and that it is planned to have the others follow in quick rotation.

It will probably take thirteen dams, Mr. Merwin said, to harness the river completely, and eventually the development will rank with Niagara Falls and the Boulder Dam project. The lake which will impound 220,000 acre-feet of water behind the Ariel Dam will be 35 miles from Longview and 45 miles from Portland, Ore., and will be a recreational center for the entire district.

Wisconsin Within a few days the Wisconsin Valley Electric Company will start the construction of a 110-kv. transmission line from Wausau to the Wissota dam on the Chippewa River, near Chippewa Falls. The project, which will be completed by November 1, will cost $800,000. It includes building a large substation 2 miles west of Wausau and the rebuilding of the 44-kv. line between Wausau and Stratford. This line will connect with the power plant of the Wisconsin Public Service Corporation at Green Bay. The Wisconsin Valley Electric Company is in the midst of an expansion program which will represent an expenditure of $2,500,000, or $1,000,000 more than the 1930 budget.

The Wisconsin Hydro-Electric Company, Amery, will spend $500,000 this year in building a 60-kv. line from Pine City, Minn., to Cumberland, Wis., a distance of 54 miles. It is expected to be complete by September 1.

Byllesby Plants Construction on four major plants now under way for the Standard Gas & Electric system is proceeding rapidly. The 60,000-kw. James H. Reed station for the Duquesne Light Company on Brunot Island, in Pittsburgh, is to be ready for operation on August 1. Substructure work on the 30,000-kw. generating station for the Oklahoma Gas & Electric Company at Belle Isle, Oklahoma City, is scheduled for completion on September 15. The Minnesota Valley steam-electric plant at Granite Falls, Minn., for the Northern States Power Company, to have a capacity of 20,000 kw., is being pushed to completion, scheduled for November 1. Satisfactory progress is also reported on the 10,000-kw. addition to the Coos Bay station of the Mountain States Power Company at North Bend, Ore., which is to be finished on July 1.

Coming Meetings

Wisconsin Utilities Association—Electric Section, Lorain Hotel, Madison, July 17 and 18. Commercial Section, Green Bay, July 31 and Aug. 1. J. N. Cadby, 105 Wells St., Milwaukee.

Camp Co-operation X—Association Island, Henderson Harbor, N. Y. July 31-Aug. 4. Society for Electrical Development, 420 Lexington Ave., New York.

Association of Electragists International—Hotel Schroeder, Milwaukee, Aug. 18-20. L. W. Davis, 420 Lexington Ave., New York.

International Association of Electrical Inspectors—Northwest Section, Bellingham, Wash., Aug. 25-27. F. D. Weber, 414 Lumbermen's Bldg., Portland, Ore. Western Section, Congress Hotel, Chicago, Ill., Sept. 15-18. W. S. Boyd, 175 Jackson Blvd., Chicago. Eastern Section, Pittsfield, Mass., Sept. 22-24. R. Walker, 85 John St., New York.

American Institute of Electrical Engineers — Pacific Coast convention, Portland, Ore., Sept. 2-5. F. L. Hutchinson, 33 West 39th St., New York.

Pennsylvania Electric Association—Bedford Springs, Pa., Sept. 3-5. Harold A. Buch, Telegraph Bldg., Harrisburg, Pa.

Empire State Gas and Electric Association—Saranac Inn, N. Y., Sept. 18 and 19. C. H. B. Chapin, Grand Central Terminal, New York.

Great Lakes Division, N.E.L.A.—French Lick Springs, Ind., Sept. 25-27. T. C. Polk, 20 North Wacker Drive, Chicago.

American Electrochemical Society — Hotel Statler, Detroit, Sept. 25-27. C. G. Fink, Columbia University, New York.

New England Division, N.E.L.A.—New Ocean House, Swampscott, Mass., Sept. 29-Oct. 1. Miss O. A. Bursiel, 20 Providence St., Boston.

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W. S. Lee

Vice-President and Chief Engineer
Duke Power Company

President-Elect of A. I. E. E.

EDITORIALS

L.W.W.MORROW
Editor

Toronto Program Emphasizes Rationalized System Insulation

THE program of the American Institute of Electrical Engineers at Toronto last week was one of the most ambitious ever attempted. Over forty papers were presented and discussed, and in addition there were the reports of the Institute's active technical committees. The magnitude of the program testifies to the intensive development taking place in all branches of electrical research and practice. But, more than that, it serves to emphasize the widely diversified interest of the membership in all phases of the art. The problems of large-scale production and dissemination of power still hold the fort because of their fundamental significance, but transportation, communication, metering and relaying had their due share, as did abstract research.

Were it not for insulation, electricity would dissipate itself as tenuously as our atmosphere. The enhancement of its effectiveness has forged ahead, now in the generators, now in the transformers and again in the lines. It has been sensed recently that a critical study should be made to co-ordinate the margins of breakdown safety in the different components of the system so as to present maximum service security with minimum over-all expenditure to obtain it. This was the subject of a well-knit group of papers, and they served to spread the gospel of a rationalized balance of graduated insulation from the generators to line points relieved by arresters.

Further evidence of the tangible service rendered to its broad membership was found in the many papers which, while lacking profundity, did supply immediate and comprehensive answers to questions of the "why" character. It is certain that a large group appreciated the opportunity of an insight into the mental processes of those who conceive, execute and anticipate the future requirements of comprehensive systems. Several papers were of this type, notably one analyzing the Ontario network and several in the system-insulation group. Such papers are inevitably voluminous, but where, if not in the A.I.E.E. volumes, should there be recorded the "hindsight" pictures which do so much to make foresight trustworthy?

Technical committee reports likewise provide the essential compendium of progress in their respective fields, showing individual forward strides in their true relation to the composite advance. The decision to assign no specific session to their presentation, merely setting aside time for their discussion, proved acceptable to the membership. Likewise, the experiment of providing for continuation of discussion of significant papers on controversial subjects beyond the limits of the scheduled session gave opportunity for the unstilted comment and querying which the "round table" facilitates. The rising generation of engineers undoubtedly will ultimately capitalize the opportunity this offers to benefit from extension of the formal discussion into the intimately informal.

Again it was an ambitious program. No more so, however, than the multiplex industry and art which it is calculated to interpret for today and record for the morrow.

Smoothing the Business Curve

APART entirely from its sociological aspects, the new General Electric employment plan has an important economic significance. It is not difficult to conceive of the elimination or at least a major reduction of periodic trade depressions by the general adoption of some such plan of maintaining purchasing power. But without widespread acceptance the general effect on business will be limited.

There are varying explanations of the trade cycle, but there can be no disagreement on its main characteristics. After a fracture takes place somewhere in the economic structure repercussions are initiated all along the line in the form of reduced consumption. This is cumulative. Payrolls are reduced and retail buying must suffer in consequence. So the circle goes on. The General Electric plan not only provides for a fund to relieve the unemployed but it aims to stabilize employment.

In both respects the net effect will be to maintain purchasing power in so far as this particular body of employees is concerned. But, admirable as is such an effect from the company's standpoint, it lacks, as we have just said, any broad business implication unless it shall be generally adopted. Furthermore, if corporate enterprise in general does not adopt some such plan, public opinion ultimately is almost certain to promote state intervention in the form of compulsory employment insurance—a much less desirable plan in many respects than a voluntary solution of the problem such as General Electric has undertaken.

Summer Lightning Data May Answer Questions

WHAT will be the harvest of knowledge from this season's crop of lightning oscillograms? At their stations of duty along transmission lines all over the country men and instruments will wait for Jove to come and pose for his photograph. The instruments will wait with the patience of inanimate things, but with all the alertness of the animate. The men will be impatient because the field of lightning investigation is still divided into schools and each is avid for the proof of its espoused doctrine.

Is it the abrupt and steeply pitched front of the lightning wave that does the damage? Or is the destructive agent the longer existing tail? What about direct strokes and induced ones? Will it be sufficient to protect only against the latter or must defense contemplate arming against the shattering bolt? The fruit of this year's crop of oscillograms may again, like last year's, lack the positive information that can be accepted as conclusive evidence in the decision of these controversial questions. But, if not this year, then next or the one after that, or later still, the answers will be found. "He that has patience may accomplish anything," said François Rabelais four hundred years ago. He probably did not have lightning investigations in mind, but the aphorism fits perfectly.

Will Sears-Roebuck Be the First?

COPIOUS quantities of printers' ink and oratory have been expended in various attempts to speed the awakening of the electrical industry to the needs for a co-ordinated nation-wide effort to sell the idea of complete wiring and the complete electrically equipped home.

No one has found any fault with the idea, but few have tried to put it into practice. If the plan has failed of support because its practicability has never been demonstrated, it appears that right now an opportunity exists for making the test.

Sears, Roebuck & Company have announced a nation-wide home-building service. If the customer owns land on which he wishes to build, he may select one of the designs, sign the necessary contract, and in from 60 to 120 days Sears-Roebuck will deliver the front-door key of his new home, then ready for occupancy. And he has fifteen years in which to pay for it.

Always interested in increasing their sales volume, Sears, Roebuck & Company could readily add 10 per cent or more to the invoice value of many homes if they were to catalog each design at two prices. The one price would cover the cost of the house with the electrical wiring according to their own standard layout. The alternate price would cover the same house but wired to conform to industry standards of adequacy and with complete electrical equipment installed.

Unquestionably many prospective home owners would instantly see the practical advantages that accrue from buying the home as an up-to-date, completely equipped unit. They would also welcome the opportunity of budgeting their income on the one-payment-per-month basis, instead of having to pay separate installments on each appliance bought from different firms and under a variety of contracts.

Sears, Roebuck & Company have a policy of

erecting these houses, wherever possible, through local contractors and by local labor. Therefore, this proposal, if carried out, would only serve to improve the opportunities for the local electrical contractors. Manufacturers of appliances and their dealers would find an increasing interest in "complete electrical equipment for the home" among owners and tenants of houses already erected. The central-station companies would enjoy higher revenue from a larger domestic load.

Why should not the industry induce Sears, Roebuck & Company to authorize the experiment and thus give a real impetus to the movement for complete electrical homes?

Statistical Exaggeration of Interstate Power

THE lack of any need for setting up a federal agency to regulate interstate transfers of energy is again made apparent by the statistics on the 1929 transactions just published by the National Electric Light Association. Approximately two-thirds of all the interstate power emanates from some thirty plants situated across state lines from their markets.

The report leaves little justification for the statement in the advance report on interstate power recently made to Congress by the Federal Trade Commission to the effect that the percentage of interstate power for 1929 would be found to have reached very much larger proportions than had been reported for previous years in the N.E.L.A. surveys. The commission has probably arrived at these much higher percentages by (1) failing to eliminate duplications occasioned when the same power crosses a state boundary two or more times, and also (2) basing the percentage of interstate power on sales to ultimate customers rather than upon the total consumption of power within the state. In this way the true value of 11.8 per cent of interstate power can readily be stretched to 14 or 16 per cent.

One interstate transaction remains one transaction and should be counted but once, no matter how many times a transmission line may cross and recross a boundary line. An interstate shipment by rail would not be counted as twenty shipments because in reaching its destination twenty state boundaries were crossed in the movement. Also, in arriving at the percentage of interstate power, the divisor can easily be made one-fourth too small by taking sales to ultimate customers rather than the total of generated and imported power, including the transmission losses.

Both these steps are illogical and would be taken only by some one intent on making a case for federal regulation regardless of statistical proprieties.

Tell the Lighting Story by Examples

NO SMALL part of the success of any program for better lighting in which esthetic as well as effective results are desired depends on the method of approach to architects and building owners. That approach can hardly be considered complete if it relies on cuts of fixtures and visits to installations where an admirable result has been attained. The best of conventional catalogs can only reflect standardized practice supplemented with a display of specially ornate or original designs; the latter may prove to be the transitory standards of the immediate future, but more often are sufficiently individualistic to go counter to the pride of the architect in his own artistic ingenuity.

An extensive compilation of photographs doing justice to the artistic execution of effective lighting installations will carry a telling story to the architect. With all the varied interior situations that present themselves to be illuminated, the presentation of a multiplicity of accomplished examples holds the promise of real appeal to the architect in his own language. It not alone aids his visualization of what he hopes to accomplish in his present job but places him in a position to carry the gospel of good lighting to clients who generally lack much capacity to visualize. One prominent manufacturer has recently met this need by publishing an attractive and useful book of this caliber. What is most to be commended is the accompaniment of the photos by sketches showing unobtrusively but instructively the features of installation which made the results possible. More such volumes would help to tell the lighting story with due regard to the psychology of those who hold the keys to its future.

Status of the Young Engineer

A plan of minimum salary increments is proposed as a means of encouraging the more promising student to finance his graduate education and fit himself for the demands of industry for superior technical talent

By HAROLD B. SMITH

President A.I.E.E.

THE young engineer of several decades ago found an old established order such that it was not advisable to present his college training, abilities, and aspirations too prominently. The older apprenticeship system had not wholly disappeared and the earlier English influences in this respect were still strong in this country. Many of our organizations were still feeling that they were showing much consideration when they paid their new men fresh from college as much as 6 to 9 cents per hour their first year. The industry has itself, and without undue pressure, recognized the financial needs of the young engineer for his own development and, under wise leadership, from time to time, has advanced the rate of compensation so that the young engineer may now expect to receive a reasonable rate of compensation upon starting upon his professional work.

There is, if not a definite agreement, a sufficiency of understanding that a young man who has made a good record, not necessarily among the first of his class scholastically, but on the whole a *good* record, through four years of engineering college training, may reasonably expect to receive $125 to $150 per month his first year out of college and, depending upon a variety of conditions, sometimes much more. Frequently it is not the job that pays the most money the first few months that is most advisable for the young man to accept for his first experience. There are compensating and counterbalancing factors of great variety to be considered, both by the employer and by the young engineer.

The needs of engineering and industry are met in the majority of cases by recruiting, shall we say, three-quarters of the men necessary from those who have secured for themselves a good four-year engineering training. The profession and the industry are most vitally concerned, however, with the recruiting of the remaining 25 per cent or less who are imperatively needed with a training beyond that which can be secured during a four-year period. These are the young men interested in securing the most thorough training for their life work, with whom the colleges, the profession, and the industry are especially concerned and for whom they are highly responsible.

One of the great difficulties of this problem lies in the suitable selection of the 25 per cent, or even 10 per cent, of the students who are so constituted that they can profitably devote one, two or three years to further training along purely analytic, theoretic or applied lines, or some advisable combination of them. This selection is attempted in various ways at present by various agencies: Fellowships and scholarships of various sorts by the colleges; grants by various foundations for many purposes; plans for support of graduate study and research, etc. There is not enough of this sort of endeavor, and when more is attempted many complications arise. It has been suggested recently that "perhaps not enough has been done by the co-operation of the several engineering societies standing back of the educational institutions and with the co-operation of the applied engineering industry as a whole."

Briefly, it is a suggestion that, after suitable study by a properly organized committee of an independent organization such as the American Engineering Council or the Engineering Foundation, with ample representation

of engineering industry, and based upon such recommendation as they find advisable, an attempt be made by these several agencies to establish some sort of differential for general and substantial recognition, if not actual agreement, which will provide a sufficiently definite rate to be expected by the young engineer of suitable characteristics for an initial starting salary after one, two or three years of effective graduate work. What such a differential should be must be a matter for much consideration, and possibly can be decided upon after actual trial. Suppose it be assumed that the following schedule is effective as fairly representing effectively minimum rates, which may reasonably be expected by the young engineer, it is believed that one of the principal advantages lies merely in the recognition of a more or less substantial understanding of such a schedule of minimum rates.

Suggested Schedule

	Minimum Starting Salary and Increments	Total Minimum
After satisfactory completion of a good four-year engineering course or equivalent.....say—	$1,750.00	$1,750.00
In addition, and after a fifth year of effective graduate work, five years, training.....say—	250.00	2,000.00
In addition, and after a sixth year of effective graduate work, six years, training.....say—	250.00	2,250.00
In addition, and after a seventh year of effective graduate work, seven years, training.....say—	250.00	2,500.00

A certain percentage of each graduating class, even though they have profited greatly from their four-year training and have good records back of them, have secured this result only at great effort, or, indeed, may have required five years in which to complete the four-year training. They have discovered that there are certain types of effort for which they are not well adapted. No one needs to tell them whether to give themselves further advanced study in college or not. They know. And fortunately there is an immediate need and an active need for just this type of man directly following his four-year training.

Then there is a smaller percentage of men who enjoy the college work of analytic and theoretic, or more practical, laboratory or research type and realize themselves that they can profit by further training of this character. It is for the benefit of men who are of the type that yield us those who go far as the years progress that this proposed plan is presented for consideration. It is also for the benefit of the profession as a whole that it is hoped that some such plan can be established so that we have coming into the profession each year a small, well-trained group of most able young engineers who will promptly find their places in the inspiring leadership of the profession.

With a reasonably definite differential set-up these are the men who would, under such an understanding, pick themselves out and under such a plan would find an urge for this training which would enable them, with the differential in mind, to finance themselves. It is believed that the right men would pick themselves out for more advanced training with greater certainty and, on the whole, truer insight into their own qualifications than their instructors or most proficient recruiting representatives could possibly do. The instructor and his advice would not be eliminated. He would still be helpful. They would have to borrow the money for this training, which the differential would permit and would justify them in doing. It would, however, make it their own responsibility to do so and ultimately repay it. They would scrutinize their own inclinations, abilities, and the character of the work they took up with utmost consideration under such conditions. They would, better than any one else, know whether their capacities and urge would justify borrowing for one, two or three years' training. They would, with good advice and better than any one else, know when such training should be interspersed with applied work of a less theoretic character.

Parliament Building in Toronto, in which city A.I.E.E. held its convention

Ewing Galloway

A Symposium on

Rationalization of System Insulation*

Seven papers sponsored by machinery and transmission committees show how lightning and arrester characteristics influence most advantageous design of insulation in generator, transformer and line

Essential Factors in Co-ordination of System Insulation—I

By A. E. SILVER and H. L. MELVIN

Electric Bond & Share Company, New York City

THE insulation of electric circuits has been prominent among the problems commanding the attention of investigators, manufacturers and operators since the beginning of electric service. In light of the new knowledge being acquired concerning transient voltages as they are imposed upon insulation, the performance of insulation and its application to power systems are now receiving renewed consideration.

Present practice for line, substation and apparatus insulation has grown up largely through actual operating experience, augmented by theoretical conceptions, research and tests, using in the main voltages from 25 to 60 cycles, together with rather meager data on transient overvoltages. Due, however, in large part to the incomplete fundamental knowledge of the nature of transient voltages and of the corresponding performance characteristics of conventional insulations many inconsistencies and variations exist. But it now seems probable that insulation layout may soon be placed on efficient and economic bases, well in advance of the present somewhat haphazard state.

Three general types of voltages are encountered by power system insulations, namely, normal frequency generated voltages, switching and system disturbance transient overvoltages, and lightning voltages. Insulating for generated voltage is quite well understood; insulating for switching surges is not a serious problem; but lightning is still uncontrolled, and no practicable amount of insulation seems adequate in itself to withstand the more severe lightning voltages encountered.

Since station equipment and terminal connections are concentrated and need represent only an extremely limited direct exposure to the influence of lightning, switching surges, or those transients arising within the circuits, may logically be taken as determining minimum or basic insulation levels. On the other hand, lightning voltages which bear no relation to generated voltages usually originate on, and influence, service by affecting the performance of lines, so that in lightning territories line insulation must be determined from the consideration of lightning. Suitable insulation strengths for lines and terminal equipment, therefore, may not bear any direct relation, one to the other. The two must, however, be coupled in an effective manner.

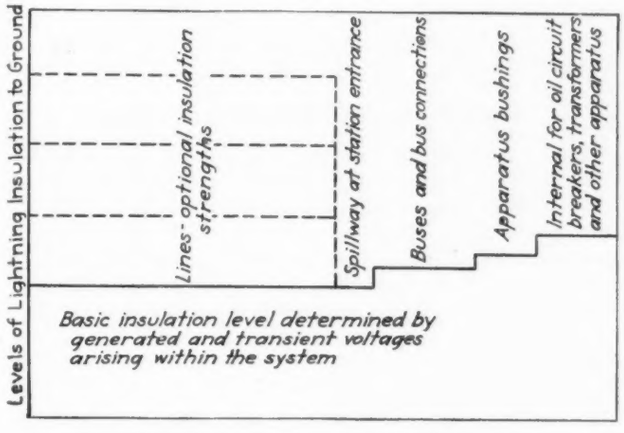
In arriving at the insulation requirements for generated voltages insulator deterioration and loss of insulation due to physical damage, either from extraneous causes or flashovers, are factors to be considered. The former, however, is not the serious problem that it was several years ago, when it was common practice to install several more insulator units in the strain position than in suspension, because of the more rapid depreciation of the former. Now, one, or possibly two, additional units are advisable to increase the insulation strength of the strain string above the normal insulation to give a margin against flashover at the more vital insulator units. Extraneous causes, such as malicious damage, animals and birds, are frequently an important factor in selecting the amounts of insulation and clearances, particularly in the lower voltage classes.

**Abstract of papers presented at summer convention of the A.I.E.E., Toronto, June 23-27, 1930.*

Recent investigations and theoretical considerations indicate that overvoltages may originate within the circuit having maximum values of five to six times the normal circuit crest voltage to ground. The nature of these surges and their magnitudes have not been fully determined, though they appear to have the characteristics of damped high-frequency oscillations. The performance of conventional types of line insulators and apparatus insulation has not been sufficiently investigated to be positive regarding their failure strengths with these types of voltages applied. From the information available, however, it seems reasonable to assume that these voltages are of sufficiently long duration to take on some of the characteristics of 60-cycle voltages so far as failure values are concerned.

More complete and careful investigation along the lines of determining the nature of switching surges and the characteristics of insulation under these voltages would seem essential. The influence of present trends toward higher speed switching on the magnitudes of switching surges should also be taken into consideration. These data are of prime importance, because the maximum values of transient overvoltages originating within the circuit may logically be used as the basis for establishing insulation levels for stations and station equipment.

On the assumption that both induced and direct lightning strokes affect line performance, there would seem to be at least three methods of attack for their control: First, the diversion of direct strokes before contact with the conductors and provision of sufficient insulation to support the maximum induced voltages;


Levels of Lightning Insulation to Ground
Lines - optional insulation strengths
Spillway at station entrance
Buses and bus connections
Apparatus bushings
Internal for oil circuit breakers, transformers and other apparatus
Basic insulation level determined by generated and transient voltages arising within the system

Relative levels of insulation for various components of the system

second, similar to the first, except for combination with conventional overhead ground wires and less insulation for the induced voltages, and, third, provision of means of discharging the lightning appearing on the conductors without generated current follow up. In addition to these are present compromise methods for minimizing the number of flashovers and their influence on service, including provision of effective amounts of insulation in combination with conventional overhead ground wires, increase of the lightning insulation strengths, and improvement in switching and relaying. Since lightning magnitudes bear no relation to the operating voltages of the exposed circuits, insulation strengths to restrain lightning will be quite independent of normal circuit voltage.

If maximum generated and switching surge voltages are used as the bases for determining the amounts of insulation for lines and terminal equipment, their insulation strengths should be the same. On the other hand, if lightning control is the basis for the line insulation strength, and switching surges for terminal equipment, no particular relation may exist between line and terminal insulation levels. However, the two must be brought together in a manner to avoid any injurious reaction of either on the other.

Co-ordination of line, substation and apparatus insulation strengths

Since it is impracticable from present knowledge completely to safeguard service against lightning voltages, it would seem essential, at least as an interim procedure, that the component strengths of the insulation along the circuit be so selected and co-ordinated that voltages, if any, which do exceed the established insulation levels will find relief by spilling at chosen locations where a minimum or no damage will result.

Viewed from the standpoint of service, to accomplish this for the substation and terminal facilities, four insulation levels, each having a suitable margin over the next lower, are proposed, as follows:

The basic, or lowest, insulation level would be the line entrance to the station, the insulation strength of this level being set at a value having a safety margin above the maximum switching or similar surge. When differing from the line insulation level, this line entrance section would be equipped as a free spillway, capable of repeatedly discharging excess surges of any kind without damage, whether originating within or without the station.

The next higher insulation level, or second defense, would be the buses and bus connections.

The next higher insulation level, or third defense, would be apparatus bushings.

The highest insulation level would be the internal insulation of apparatus, thus placing this most expensive and most difficult to repair portion of plant in the position of maximum security against overvoltage and rendering each item of apparatus self-protecting in itself.

With the foregoing voltage levels throughout the station separated by proper intervals, it is believed that excess voltages of any nature appearing at the station will find relief at the spillway sections at the line entrances. It is assumed that direct strokes of lightning to the power conductors within a station will be avoided by utilizing the supporting structures, perhaps reinforced by grounded overhead cables, as diverters.

Even though definite values for these intervals between insulation levels cannot be intelligently assigned at this time, nevertheless, pending more dependable knowledge of the problem, approximately 10 per cent between the spillway at the station entrance and 5 per cent between bus and apparatus bushings are proposed for trial to advance the experience on this point. These intervals represent the minimum separations between the impulse sparkover curves for the various insulators and spillway gaps throughout a range of waves from very short to relatively long durations, or between volt-time curves extending to possibly 20 microseconds.

So long as lightning voltages of magnitudes beyond practicable control must be dealt with, occasional discharges at the spillway gaps as proposed must be accepted, but these should occur without injury to station apparatus and insulation. However, with these gaps spilling freely in air, service interruptions will result. There is, then, a strong need for a simple and efficient barrier to normal frequency follow-up current to place in these gaps without impeding the unrestricted discharge of the lightning surge, even though its origin be at the spillway. Such devices are not as yet available.

More complete fundamental knowledge of the nature of transient overvoltages originating within the circuit, and especially of lightning voltages at their origin upon circuits, is essential in order that the characteristics of insulation under these voltages may be fully investigated. This work is progressing, though it must be realized that it is a large task and time will be required for the development of instruments and technique, as well as for the actual accumulation of the data.

Three Standard Impulse Waves Proposed—II

By PHILIP SPORN

American Gas & Electric Company

THIS PAPER presented the composite attitude of the lightning and insulator subcommittee in regard to rationalization on insulation. Several of the committee members believe strongly that a lightning wave cannot be standardized at the present time; another group, however, feels equally convinced that a single wave or group of waves can be standardized to great advantage at the present time. In a previous paper by the author, one which is usually credited with being the opening gun of the barrage directed at the system interruption problem, it was pointed out that the principal high voltages which have to be insulated for are those due to lightning; in other words, the unsolved lightning problem is the one barrier to continuity of service. Further data, accumulated since then, have resulted in a further check of the correctness of this statement. For example, on the 132-kv. system of the subsidiaries of the American Gas & Electric Company the lightning outages in per cent of total outages have been as follows: In 1926, 81.6 per cent; in 1927, 77.2 per cent; in 1928, 68.2 per cent; in 1929, 75.7 per cent.

Data of the above type can leave no question of the predominance of lightning as the source of trouble; in other words, that the lightning problem is the paramount insulation problem. Nor is there any doubt that at the present time lightning is only very little controlled. Yet, in the face of all that, the power frequency (which in most cases means 60 cycles) is the frequency at which insulation strength is measured and in terms of which it is designed, built, sold and installed. The logic of this is rather hard to defend; in fact, one may doubt that there is any logic in it.

The unhappy results of lack of rationalization continue to pile up. In a previous paper there was cited a considerable number of failures on 132-kv. transformers; others have since developed. In another instance, during a lightning storm high voltage entered one phase of a 132-kv. transformer bank and jumped through the oil to the ground sleeve of the bushing. The transformer was put back into service and was apparently entirely satisfactory, but at the end of four hours tripped again. Again, a number of cases have since been experienced with failure of 132-kv. coupling capacitors, used for carrier-current communication, these capacitors being in each case of the dry mica type. In each case the failure was during a lightning surge on the system.

There is another aspect of the generation and transmission problem which makes insulation rationalization very necessary and that is the development of high-voltage generation. With the higher generating voltages obtainable today the ideal always sought, but not often found, of distribution at generating voltages is again obtainable in many cases, but here again the problem of insulation for high voltages, where feeders connected to overhead transmission systems are to be fed from these buses, is complicated by the problem of lightning strength of the generator windings.

Overinsulation inadequate expedient

The development of the idea of overinsulation of transmission lines is of rather recent occurrence and once again contributes to the chaos instead of solving the problem of rationalization of insulation. In the last few years there has been a very definite economic drive to obtain transmission line service with fewer outages. The types of load that have been taken on have in most cases demanded service continuity of the highest sort, and this has led to the raising of the insulation level to heights undreamed of a few years ago. Thus, we have had a recent 220-kv. development designed with eighteen 5¾-in. units for the transmission line. Again, the use of wood poles, wooden crossarms and braces has spread over the last few years, with the probability that their use will spread further in time to come. In many of these cases the use of wood has resulted in the setting up of insulation barriers that have permitted voltages of as high as 2,450,000 to be measured on moderate voltage transmission lines, with an indicated voltage in the order of 4,000,000 at the point of flashover.

Still another problem that adds to the gravity of the insulation situation has been the uncertainty of lightning arrester operation.

A first examination of the present status of rationalization gives the impression of a rather hopeless situation. Very little progress has been made since 1928. To date,

therefore, the same chaotic situation with regard to data on insulation strength, particularly with regard to data on competitive equipment, exists, as was pointed out previously. In fact, the more the situation is examined the more confusing it appears. Even the 60-cycle flashover value for standard suspension units *of the same spacing and of substantially the same design* as given by various manufacturers does not agree; differences of from 10 to 15 per cent are quite common.

As regards the lightning phase, there is still apparent the same tendency to let well enough alone.

The insulator and bushing manufacturers, it may be stated very definitely, have done little toward the problem of co-ordination in which they should be vitally interested.

In the laboratory many fundamental researches have been undertaken as to the characteristics of various types of insulation under surge conditions. The work of Peek and Torok on the characteristics of insulation as affected by time and voltage is typical of this work. In the field a large number of investigations with artificial and with natural lightning have been carried through, and particularly valuable data were obtained during the past year.

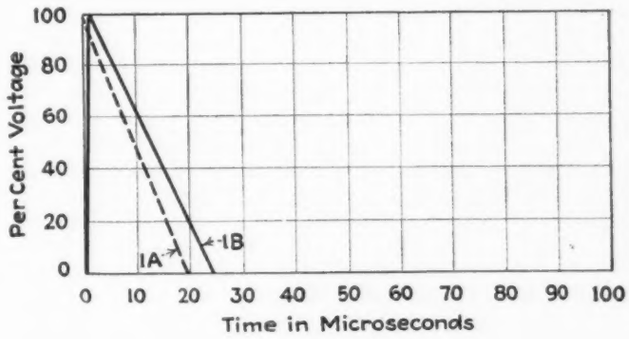
Several committees of the Institute have taken the problem for their own and have done a considerable amount of work on it.

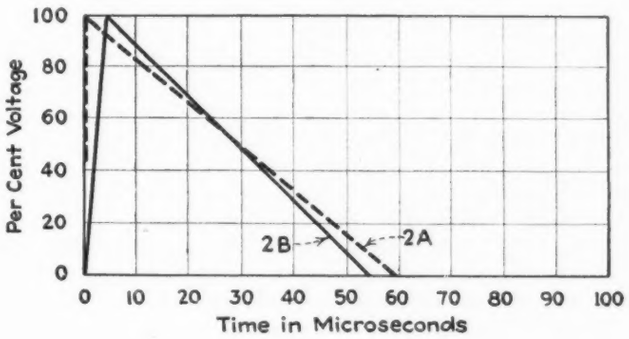
If, as is admitted, the major insulation problem is that under lightning conditions, then it is almost axiomatic that, before any definite progress can be made in design or co-ordination, the first thing necessary is the knowledge as to fundamental lightning strength of all links of insulation in the transmission chain. Expressing this strength in terms of any other unit—for example, in terms of the power frequency unit—is most certainly not satisfactory and will only result in delaying progress in the solution of the problem.

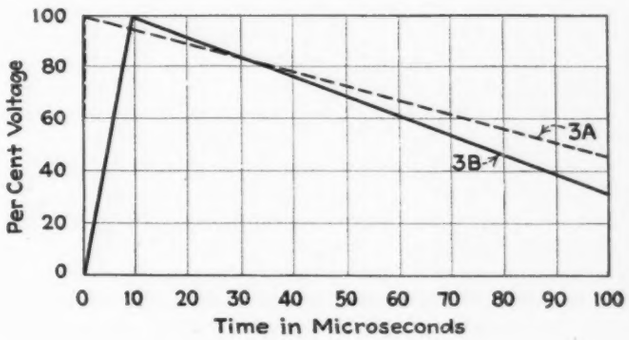
It is admitted that a single wave would cover the situation rather unsatisfactorily, but it is not necessary to limit the standard to a single wave. It is possible, for example, to adopt three different waves, and this is the proposal now made in this paper: That three waves referred to as 10-microsecond, 30-microsecond and 90-microsecond waves be adopted. It is proposed that all waves have a $\frac{1}{4}$-microsecond front; the time referred to in the designation of the waves may be considered as a special time constant and is the value in microseconds required for the wave to fall to 50 per cent of its crest value.

One of the great obstacles to a rationalization program is the failure to adopt some definite unit in which to express lightning insulation strength. To express it in terms of 60-cycle strength, when what is aimed at is rationalization on the basis of lightning insulation strength, seems illogical for several reasons:

(a) It is not known that the relationship between 60-cycle and lightning voltage is the same for all types of insulation generally used, even for one given type of lightning wave.







A waves are proposed as standard lightning test waves; B waves are averages of waves observed in the 1929 field studies

(b) The ratio of 60-cycle to lightning voltage breakdown of apparatus differs with the variations in design of a piece of apparatus even for a fixed lightning wave.

(c) There is at the present time a lack of agreement on the 60-cycle dry flashover values on insulators of equivalent design as determined by data obtained at different laboratories of recognized standing. It would therefore appear to be better and more desirable to standardize lightning insulation strength on the basis of a lightning wave of definite characteristics of its own rather than on a 60-cycle basis.

As a first step in this plan, a set of three standard impulse waves is proposed in terms of which all types of insulation are to be tested. All three waves considered are to have a $\frac{1}{4}$-microsecond front and are to attenuate to 50 per cent of crest value in 10, 30 and 90 microseconds respectively. The values and shapes chosen are very similar to wave shapes of natural lightning obtained on actual transmission lines, and ought therefore to approximate actual conditions insulation and apparatus may have to withstand in the field.

Law of Impulse Spark-over and Time Lag—III

By F. W. PEEK, Jr.

General Electric Company

THIS paper discussed the relative effects of different forms of voltage transients on insulators, gaps and insulation, to show how the effects and breakdown voltages of various types of transients are related and to compare natural lightning waves with those used in the laboratory. Such knowledge is necessary in making a comparison of insulators, insulation and in co-ordination. The law of impulse spark-over has been determined and formulas have been developed to predetermine time lag and breakdown voltage for the various types of transients.

He reviewed the principles set up in the three previous papers of his series on this subject and proceeded to discuss the various types of impulse tests from their voltage and energy-breakdown standpoints.

In the early work with the lightning generator it was necessary to decide on some wave or waves which would have the effects of the average severe lightning on insulators, insulation and apparatus. As tentative standards two waves were decided upon for general testing and comparison of insulators and insulation—that is, the 5- and the 20-microsecond waves. These waves reach crest in ½ microsecond, decrease to half voltage in 5 and 20 microseconds and to zero in 10 and 40 microseconds respectively. Typical measured natural lightning waves in general produce the same effects on lines and apparatus as the laboratory waves. *It is probable that insulator spark-overs frequently occur on the rising front of the wave.*

Over one hundred oscillograms have been obtained of traveling voltage waves due to lightning on transmission lines. These waves had generally come a considerable distance and were thus greatly reduced in voltage, modified to some extent by attenuation, reflections, etc. In most cases they were evidently caused by storms some distance away. It is interesting to examine these waves with the view of determining just what impulse spark-over voltages should be expected. The importance of this is seen when it is remembered that surge voltage recorder measurements indicated that lightning spark-over voltages were usually 1.8 or more times the 60-cycle voltage, although it is known that the impulse ratio varies widely with different waves and is dependent on conductor polarity. To make this examination complete it is necessary to see what happens at the point of origin of the wave where the induced voltage V is maximum.

It would appear that with reasonable assumptions as to length of bound charge (for example, 2,000 ft.) and rate of cloud discharge, the average measured wave in the accompanying figure can be accounted for by induction and maximum voltage values of over 2,000 kv. can be expected.

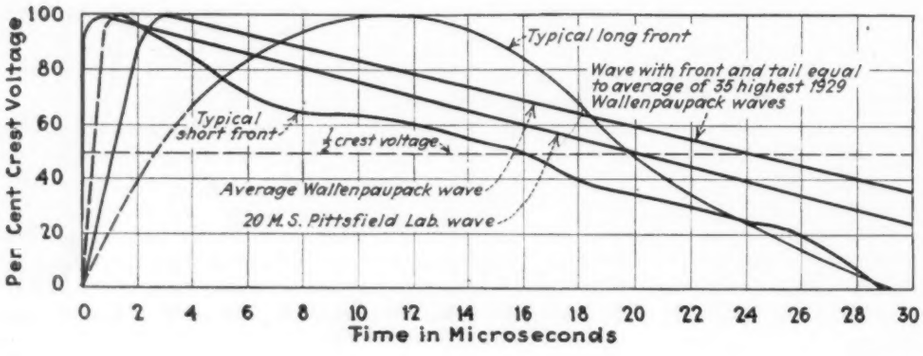
In case of direct strokes the wave would probably be still steeper and thus give impulse ratios over 1.8. Direct strokes become of relatively more importance as a cause of spark-overs as line insulation is increased or on the higher voltage lines.

While the above analysis can only be approximate, it is still probably accurate enough for its purpose.

Basing co-ordination on standard waves

However, it would be of great convenience to have a standard wave particularly for the purpose of making a comparison of various types of insulators, bushings and gaps. Such data are needed for co-ordination and to determine the ability to spark over without puncture. Such a wave should be easy to duplicate, should permit of many tests in a short time and should produce the effects of severe lightning. The most severe lightning effects usually occur with high impulse ratios, particularly where solid insulations are present.

There is no reason to make impulse tests for an impulse ratio approximating unity because the effects are the same as at 60 cycles. A wave giving impulse ratio above 1.8 seems reasonable. This could be obtained, for example, by a uniformly rising wave reaching spark-over in about 2 microseconds, or preferably by a standard wave (with 50 per cent sparking) of ½/5 or ½/20. The full fixed standard wave is by far the simplest method and is least subject to error. A greater range of effects could be obtained with a long and a short standard


Per Cent Crest Voltage
100
80
60
40
20
0
Typical long front
Wave with front and tail equal to average of 35 highest 1929 Wallenpaupack waves
Typical short front
½ crest voltage
Average Wallenpaupack wave
20 M.S. Pittsfield Lab. wave
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30
Time in Microseconds

Average observed lightning wave in contrast with Pittsfield laboratory waves

wave. Several impulse ratios could also be obtained by the full standard wave and by fixed wave overvoltage. The fixed full wave method with one or two standard waves is therefore recommended. For testing special types of apparatus it may sometimes be necessary to use a circuit giving proper energy relations of traveling wave on a line.

What co-ordination means

Co-ordination means the adjustment of lightning breakdown voltage between the transformer or other apparatus and the adjacent line insulation, so that if lightning voltages become high enough line spark-over will occur and limit the incoming voltage waves sufficiently to prevent transformer or other apparatus failure. It is not intended to take the place of lightning arresters or other protective devices, but rather to act as a safeguard against very heavy discharges and in case the arrester is out of service. If the arrester is operating satisfactorily it will prevent spark-over on the co-ordinated gap. The gap is thus also a good check on the condition of the arrester. Co-ordination may be effected either by the use of the standard insulation for half a mile from the station or by a specified gap at the station and within 100 ft. of the apparatus. Co-ordination permits the use of extra insulation wherever desirable on other parts of the line. Since the co-ordinated section is relatively short the use of normal insulation on this portion usually has very little effect on the outages. If desirable, extra ground wires can be used over this section. The transformer bushing is generally made stronger than the line insulation, but weaker than the transformer insulation. Co-ordination has been in use on one 220-kv. line for several years. The co-ordinating gap has flashed over many times during this period without damage to the transformer.

The field investigation of lightning indicates that:

The average lightning wave, even with maximum voltages sufficient to cause spark-over on a 220-kv. line, can be accounted for by induction, with reasonable assumptions as to size of cloud and rate of discharge.

Spark-overs may be caused by either induced voltages or direct strokes. Direct strokes become of proportionally increasing importance as causes of outages when line insulation is increased.

Voltages giving impulse ratios of the order of 1.8 cause a large percentage of the spark-overs on high-voltage lines.

Waves giving low impulse ratios are not representative of average field conditions, and do not give severe enough effects for impulse testing.

Statistics compiled from lightning records gathered from widely scattered power systems substantiate the fact that the standard laboratory waves ($\frac{1}{2}/5$ and $\frac{1}{2}/20$) discussed above give effects truly representative of average field conditions. These statistics also serve as a valuable basis for considering economically the line insulation necessary under different conditions.

It therefore seems quite proper to consider the above standard lightning wave as a rational basis upon which to compare insulator and insulation strengths in the general problem of co-ordinating line and apparatus insulation.

Co-ordination of system insulation on transmission lines has been used on important systems and its value is now recognized. The law of time lag given above permits the proper co-ordination under all conditions.

Insulation of Lines and Station Structures—IV

By C. L. FORTESCUE

Electrical Engineer
Westinghouse Electric & Manufacturing Company

THE improvement in the insulation of transmission lines has created some concern in the minds of manufacturers of transformers as to the severity of the surges which, as a result of the increased insulation, will have to be met by the insulation of station apparatus, and it would be wise to limit the insulation of the transmission line to correspond with the voltage class of the apparatus installed, in conformance with the results of past experience with apparatus in the field. The suggestion has been made to limit the insulation of the transmission line for a half a mile outside the station.

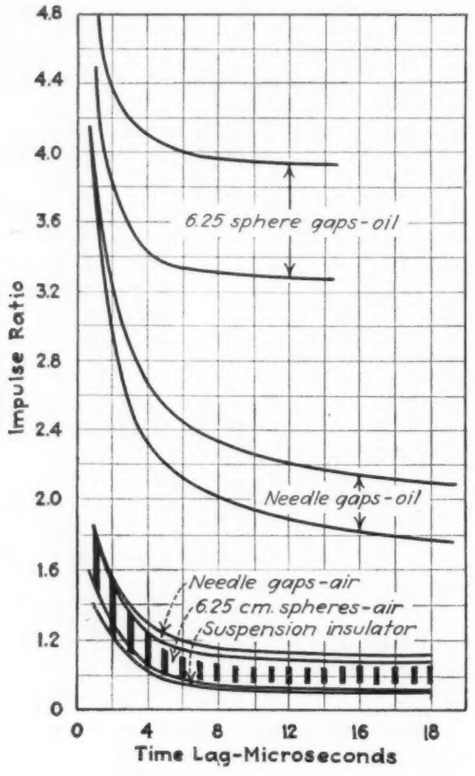
There has been some criticism of this procedure on the part of some engineers on the score that where lightning arresters are used to protect the station apparatus it is unnecessary to cut down the insulation of the transmission line in the neighborhood of the station. However, this argument is not very logical, for the reason that as regards insulation the presence of the lightning arrester in itself cuts down the requirements of the substation and nearby points on the transmission line for the reason that the protection afforded by the lightning arrester extends to some distance from its point of installment.

As a protective measure for the transformers, the reduced insulation is not intended to replace the lightning arrester, but is intended as a back-up protection and in case something happens to the lightning arrester. It should not be assumed that an insulator string constitutes a good lightning arrester, as its flashover time-lag characteristics are not conducive to its functioning as a lightning arrester.

Impulse flashover characteristics of insulating structures

Our laboratory work on lightning has been carried out on the proposition that the characteristics of insulating strings should be based on the most severe type of lightning that is likely to be encountered. This has a further advantage in that the curves obtained in this

manner are drawn in volts and time lag of flashover, and completely specify the impulse time-lag characteristics of the insulating structure or insulator without regard to the shape of the wave, and the behavior of the insulator string for any shape of wave can be very easily obtained from these characteristics.



Impulse ratio for insulators and spark gaps in oil and air

It is obviously of great importance for transmission engineers to know the flashover voltage time-lag characteristics of the various types of insulating structures that enter into their transmission line and station designs. The flashover voltage time-lag curve of the insulator string provided with arcing rings will cross that of the plain string somewhere in the neighborhood of 8 microseconds; hence for waves that take more than 8 microseconds to flash over the plain string, the string provided with arcing rings will have a shorter time lag, and will therefore flash over before the plain string, but for surges that take less than 8 microseconds to flash over the plain string, the string provided with arcing rings will have a greater time lag, and therefore such a string will take a higher voltage to flash it over with the same time lag. Since about the longest time lag for a lightning wave to flash over an insulator string is 15 microseconds, in order to bring the impulse flashover strength of the two to equality at this point, the string provided with arcing rings would have to have its 60-cycle flashover raised in inverse proportion to the relative value of the impulse ratio at this time lag.

It does not follow that because an insulator string provided with arcing rings and with its 60-cycle voltage raised so as to produce equal impulse strength at 15 microseconds has higher time lag for waves which flash over at less than 15 microseconds it will result in lower outages on a line than the simple string. It is true that with lightning waves of short duration this will be the case, but such lightning waves are not sufficiently numerous to be of any great consequence in determining outage factors.

With high surges of long duration, the string provided with arcing rings will flash over just as frequently as the plain string. Considered from the point of view of the severity of the chopped wave which will pass an insulator after flashover, the insulator string provided with the arcing rings will be much worse than the plain string. Consequently, in the recommendations for reducing insulation in the neighborhood of stations, it is stated that the insulator string corresponding to the class of transformer used at the station shall be an unshielded string. Therefore, in rationalizing station insulating structures with the line only plain insulator strings should be considered, or if shielded strings are used, the 60-cycle flashover should be sufficiently reduced so that the time lag at the higher surge is no greater than that of the plain string specified.

Station insulation and transmission line insulation

Obviously, the station insulating structure should be rationalized wherever possible with respect to the transmission line and not with respect to any extraneous device such as the horn-gap, since the object is to insure that the station insulation will be at least as strong as the line insulators adjacent to the station, so that if a flashover should occur it will occur on a line and not on station apparatus. In contrast to the line flashover which occurs and is suppressed without damage, flashover in the station insulating structure may involve more than the particular structure which flashes over and may result in serious damage to the station and a prolonged outage.

Measurements have been made in the laboratory of the impulse ratio range of pillar type insulators, and it has been determined that this range is above that of suspension insulator strings; consequently, if at 15 microseconds the 60-cycle flashover of the pillar type insulator is slightly higher than that of the insulator strings near the station, the pillar type insulator will be properly rationalized with respect to the transmission insulation. Other important insulating structures used in stations are outlet bushings which form part of circuit interrupters and transformers. The impulse ratio time-lag characteristics of bushings may be modified by proper terminal arrangements so that they will have the same flashover voltage time-lag characteristics as the insulator string over a range of 20 microseconds, and if the flashover voltage at each value of time lag is made 5 per cent higher than that of the transmission line insulators, the conditions of rationalization are satisfied.

The insulation of the transmission line can be graded for one-half mile outside the station without increasing the outage factor for this portion of the transmission line as compared to the rest of the transmission line. In fact, the insulation could be graded down to the insulator string or structure which would be just protected by the lightning arrester at the station.

It will now be evident that the proposed rule to grade the insulation of the transmission line down for one-half

mile outside the station is not purely an arbitrary decision, but has good theoretical basis, because, while the arrester is at the station, it is not necessary to have the full insulation at points near the lightning arrester in order to maintain the outage factor, and if the arrester is absent for some reason it is essential as a back-up. Of course, at the station the outage factor with a properly designed and applied lightning arrester is zero, and at a short distance out from the station with the proposed reduced insulation the outage factor becomes the same as that of the transmission line. From that point out to the end of the half-mile distance the outage factor will be somewhat less, the average over the whole half mile being about the same as that of the line.

Insulation Co-ordination as a Design Problem—V

By G. D. FLOYD

Testing Engineer
Hydro-Electric Power Commission of Ontario

IT SEEMS certain that with the present types of lines one or two flashovers per year are bound to occur in lightning areas, no matter what the design. The cost of towers, as well as of insulation, will increase rapidly if the number of insulator units required to make the line 100 per cent proof are specified. The increase in cost cannot be justified, unless in some very special cases of important tie lines of short length. It would appear to be better to concentrate on means whereby the line may be cleared rapidly, before the power arc can do material damage, and accept the momentary interruption. This may not involve a total interruption in many cases, because of the increasing degree of interconnection of power sources, and the fact that power demands have increased to such an extent that a number of high-voltage lines are necessary to serve most districts where service security is of paramount importance.

If flashover is to occur, it is always better that the overstress be relieved at a point where least damage will result. The difficulty is that it is practically impossible to design the various members so that failure will occur for all types of surges and all conditions at a given location, unless the insulation is so greatly weakened that there is danger of flashover for surges that would be harmless otherwise. It is not sufficient to design so that the oncoming wave will encounter slightly higher insulation as it progresses into the station because possible reflections at points of discontinuity make it necessary to have the insulation greatly stronger at such points.

Arrester ceiling voltage

The co-ordination of station insulation resolves itself into designing the various parts to have greater strength than the arrester ceiling voltage. A number of exceptions to the above general condition are evident. In the case of outdoor stations the length of bus may be such that an arrester, if located at the line entrance, may allow surges to pass, of sufficient magnitude to be dangerous to station insulation because of reflections. In these cases the proper place for the arrester is adjacent to the transformers, as the reflection is usually highest at this point. Bus insulation can be more readily strengthened to take care of reflection at those points where it may occur.

A condition requiring special treatment occurs in those cases where other than normal number of units are required in the arrester stack to protect the arrester against dynamic overvoltage due to loss of load. The ceiling voltage of the arrester is increased in these cases and the protection given is correspondingly decreased. The term ceiling voltage is defined as the maximum crest voltage at arrester location permitted by the arrester for all types and magnitudes of surges. If the increase in ceiling voltage is appreciable, either the insulation strength of the transformer should be increased or some of the special features of co-ordination of line and station insulation attempted. It is felt that the former arrangement is preferable, as the latter is still of too uncertain a nature to be depended upon, especially for stations of large capacity.

A third case is one which applies most particularly to some 220-kv. systems, where advantage was taken of a solidly grounded neutral to specify graded insulation. In these cases it would be expected that an arrester with the normal protective ratio might not be quite good enough to protect the transformer against all surges. Co-ordination of line and station insulation may then be used as a last resort, or a spillway or protective gap installed, but drastic reduction in insulation strength on the line adjacent to the station appears to be necessary, with its attendant difficulties due to line outages.

The trend of co-ordination

The trend of insulation co-ordination appears to be somewhat as follows:

1. Knowledge of insulation required for both line and station apparatus has been acquired largely as a matter of experience, and a co-ordinated system has resulted.

2. Increased line insulation has come about as a result of

   (a) Recent investigations into behavior of lines and line insulation when subjected to surges.
   (b) Better knowledge of magnitude and character of lightning surges.
   (c) Desire to decrease the number of line outages, especially on important circuits, with relatively high loading.

3. Knowledge of the behavior of station insulation is still such as to allow only very general approximations to be made. The situation is complicated by the very intricate nature of voltage reflections which may occur at points of discontinuity.

4. Station insulation has not been increased because the amount of increase necessary could not be accurately specified, and also because of the difficulty of modifying existing stations to the new insulation design.

5. If the valve type lightning arrester is used, it is a determining factor in station insulation requirements.

Horn Gaps for Surge Protection of Transformers—VI

By J. A. JOHNSON and E. S. BUNDY

Buffalo, Niagara & Eastern Power Corporation and Niagara, Lockport & Ontario Power Company, Respectively

IN A territory subject to a given statistical number of lightning storms per year producing a given number of discharges per unit of area, the number of outages occurring on a given transmission line will be a function of two factors which may be broadly and briefly stated as (1) strength and (2) length. The number of interruptions per year on a given line, other things being equal, will be in proportion to an inverse function of its insulation strength and a direct function of its length. We have become accustomed during the past few years to sum up the insulation performance of a transmission line in terms of flashovers per mile per year, but unfortunately the standard of service to customers dependent upon the continuity of the line, which is the basic determining factor, depends not upon the number of interruptions *per mile* per year, but upon the *total* number of interruptions per year. Thus it follows that if equal service is to be rendered by lines of unequal length, the insulation strength must be varied in inverse proportion to the length of the line.

Transformers connected to overhead transmission circuits must be built to withstand lightning surges in some degree. The only question is as to the degree of strength which they should possess. There are three alternatives: (1) The transformers may be built to withstand the maximum surges which they can receive from any line, or (2) the transformers may be built special for each installation to withstand the maximum surges which can be received from the actual transmission lines, or (3) the transformers may be built to withstand surges of a definite maximum amount and protected against surges of a higher value.

Limited surge value for transformer

We are forced to the adoption of the third alternative, namely, the standardization of transformer insulation to withstand surges of limited magnitude. This also involves the problem of protecting the transformer against surges of greater magnitude than it is designed to withstand. Both of these problems, it should be observed, are questions of standardization.

To sum up, it is evident that the transformer is a manufacturing problem and calls for a standardized solution, whereas the line is a service problem and demands an individual solution. Co-ordination between the two, therefore, appears quite impossible.

The problem still remains of protecting the transformer against surges too severe for it to withstand. Again there are two ways in which we can proceed: (1) The first alternative is to specify exactly the magnitude and characteristics of the maximum surges which the transformer will withstand, leaving the user to determine as best he can the required protection. This alternative demands intricate scientific knowledge of natural surges and of the behavior of insulation, which is not now and may never be completely available; (2) the second alternative is to standardize the characteristics of protective devices. Such devices may be much simpler and their characteristics much more easily determined and more closely controlled than those of the transformer and therefore may lend themselves much more readily to standardization with respect to surge voltage characteristics. Such devices may be separate pieces of equipment, or may be a part of the transformer.

Horn gaps successful at Niagara

The paper gave a brief account of the development on the system of the Buffalo, Niagara & Eastern Power Corporation of a simple horn gap protective scheme which is now generally used on this system and has behind it a record of some twenty years or more of satisfactory operating experience. This experience demonstrates that such devices will give adequate protection to transformers without themselves causing unnecessary interruptions.

The gaps on the 110-kv. system are set at 13 in. and 18 in., corresponding to 60-cycle flashover values of approximately 150,000 and 250,000 volts.

The proper gap settings have been determined largely by experience. On the 60-kv. system operating at 25 cycles the switching surges are not severe and only slight changes have been made since the first gaps were put in service. On the 110-kv. system the first gaps were installed in 1925, when the entire system consisted of two parallel lines 40 miles in length. The gaps were first set at 11 and 14 in., but it was found that switching under some conditions would cause the fused gaps to arc. The gaps were then increased in length to 12 and 15 in. and no trouble was experienced until the system became more extensive and the length of circuits switched at one point became greater. It was finally found that with settings of 13 and 18 in. no trouble resulted from switching and the records show that no failures of equipment connected to the 110-kv. system have occurred.

On both the 60-kv. and 110-kv. systems the operation

Comparison of B., N. & E. Practice With Proposed Standards

60-Cycle Dry Flashover Voltages

Nominal Line, Kv.	Proposed Standard Gaps, Kv.	B., N. & E. System Flashover, Kv. — Line Insulation	Fused Gaps	Ground Gap
69	185	255 (4 units)	75	100
69	185	400 (7 units)	75	100
115	300	400 (7 units)	150	250

of the horn gaps has been very successful in protecting the terminal equipment, since there have been practically no failures during lightning storms.

Horn gaps meet proposed standards

During the progress of this development the line insulation has been progressively strengthened to withstand lightning surges and give the required character of service. As a result, both 60-kv. and 110-kv. long-distance lines now carry the same standard insulation of seven units, though certain short 60-kv. lines are operating entirely successfully with four units. In all cases the standard line insulation is maintained right to the station structure.

Comparison of the above safety gaps with those proposed by the transformer subcommittee for insertion in the Standards, as shown in the accompanying tabulation, reveals that the gap flashover voltages actually used on the system described are considerably lower than those recommended as standards.

Since the evidence of actual operation shows that the smaller gaps do not cause unnecessary interruptions, it is obvious that the recommended gaps will not do so under like conditions. On the other hand, in view of the relatively complete knowledge of the surge characteristics of gaps, there would seem to be no doubt that the recommended gaps will give adequate protection to the transformers.

Committee Recommendations for Co-ordination—VII

By V. M. MONTSINGER and W. M. DANN

General Electric Company and
Westinghouse Electric & Manufacturing Company, Respectively

THE need of new insulation standards on account of the practice of increasing the line insulation has long been recognized by interested manufacturers and operators and may now be said to be a necessity. Failure to adopt such standards has been due chiefly to lack of general recognition and acceptance of their proper governing factors, together with the difficulties of verifying them in the completed apparatus. Commercial methods for demonstrating the impulse strengths of transformers by acceptance tests in the factory are still not feasible. To make such a test on a transformer might cause undetected injury which would later result in failure in service; on the other hand, sufficient field experience and experimental data are now available by which it is possible to set up certain standards for the co-ordination of line and apparatus insulation.

Realizing the need of a more rational method of insulating high-voltage transformers the transformer subcommittee of the electric machinery committee in 1927 undertook the preparation of a set of recommendations for defining the impulse-voltage strength of transformers and for balancing the transformer with the adjacent line insulation.

While these recommendations have been completed and are used by the manufacturers for expressing the impulse strength of transformers, they have not yet been recognized by the Institute for co-ordination purposes.

Before attempting to get any action by the Institute, it was agreed that the transformer subcommittee and the lightning subcommittee of the transmission committee sponsor the symposium of papers being presented at this session. It is hoped that as a result of all these papers a definite set of rules can be agreed upon which will be acceptable to all concerned.

The purpose of this paper is to give the recommendations prepared by the transformer subcommittee together with a discussion of some of the more important phases of the subject matter.

The proposal is divided into two distinct parts, Part I dealing with a method of defining the impulse strength of transformers and Part II giving recommendations on co-ordinating the transformer and adjacent line insulation.

Part I—Impulse Voltage Strength of Transformer Insulation

(a)—Transformers Receiving Standard Dielectric Tests, as Specified in Par. 13-400, A.I.E.E. Standards No. 13.

Apparatus conforming with the standards of dielectric test should be so designed that their impulse strength against lightning is greater than the impulse flashover voltage to earth of non-shielded suspension type insulators having a 60-cycle r.m.s. dry flashover in accordance with Table I.*

TABLE I

Rated Circuit Voltage, Kv.	Transformer 60-Cycle Test Voltage, Kv. r.m.s.	Insulator 60-cycle Dry Flashover Voltage, Kv. r.m.s.	Corresponding† No. of Insulator Disks Spaced 5¾ in. Apart
69	139	250	4
92	185	350	6
115	231	400	7
138	277	450	8
161	323	550	10
196	393	640	12
230	461	725	14
...	510†	810†	16
...	570†	895†	18
...	625†	980†	20

(b)—Transformers Receiving Higher Than Standard Test.

If the 60-cycle dry flashover of the adjacent line insulation is greater than the value given in Table I, and is not locally limited to that value, transformers having a dielectric test corresponding to the actual adjacent line insulation should be used.

(c)—Transformers Receiving Lower Than Standard Test, as Specified in Par. 13-402 (n), A.I.E.E. Standards No. 13.

Transformers used with solidly earthed neutral and having the reduced insulation test of 2.73 times line to neutral voltage should have an impulse strength equal to that of a standard transformer for the next lower circuit voltage.

*Commercial methods for determining the impulse strength of transformer windings by acceptance test in the factory are not feasible. However, investigations in the laboratory show that the impulse strengths of transformer insulation and of standard line insulators or of air gaps vary similarly with different forms of waves; also that the impulse ratio of strings of line insulators of different lengths is approximately constant for the same impulse waves. The forms of impulse waves actually occurring on transmission lines have not been fully determined. For these reasons, the impulse strength of transformer windings is expressed in terms of the 60-cycle dry flashover voltage of line insulators.

†These do not appear in the rules as proposed, but are given here merely for reference purposes.

Part II—Recommendations for Co-ordinating Transformer Insulation with Line Insulation in the Field

Limitation of lightning voltages, on the portion of the circuit adjacent to the apparatus, to the lightning flashover voltages of line insulation having the 60-cycle flashover voltages given in Table I may be accomplished by the use of one or more of the following methods:

Method 1—An effective and properly applied lightning arrester connected to the circuit within 100 circuit feet (30 m.) of the terminals of the apparatus.

Method 1 furnished the most effective protection, but in the absence of standards for lightning arresters and their installation, method Nos. 2 or 3 should always be used in combination with method 1. If the impulse strength of the supporting insulation of the arrester conforms to the impulse strength of the gap with settings as given in Table II, then no additional parallel gap is necessary.

Method 2—A suitable safety gap connected between each conductor of the circuit and earth within 100 circuit feet (30 m.) of the terminals of the apparatus with gap setting not in excess of the flashover voltage given in Table II.

TABLE II

Rated Circuit Voltage, Kv. r. m. s.	Transformer—60-Cycle Test Voltage, Kv. r. m. s.	Gap — 60-Cycle Dry Flashover Voltage, Kv. r. m. s.
69	139	185
92	185	240
115	231	300
138	277	335
161	323	410
196	393	500
230	461	585

These values apply to either arcing horns or rings attached to insulator strings or to points mounted separately. If rings are used, in order to avoid affecting the impulse ratio* the gap should not be greater than 80 per cent of the length of the supporting insulator string.

Method 3—Limitation of the line insulation to earth from points within 100 circuit feet (30 m.) of the terminals of the apparatus to points approximately ½ mile (1 km.) therefrom, to values not in excess of the flashover voltage given in Table I.

*Ratio of impulse to 60-cycle crest voltage arc-over.

Recommendations for balancing the transformer and transmission line insulation

So far the method of expressing the impulse strength of transformers only has been discussed. It is quite important, however, that steps be taken by the purchaser to carry out the principle of balancing the transformer and the line insulation. If this is done, then the main part of the transmission line may be overinsulated without increasing the size and cost of the transformer.

Three methods are recommended, namely, (1) the use of an effective lightning arrester; (2) the use of a horn-gap, and (3) the maintenance of average line insulation for a limited distance from the station.

Method 1—Lightning Arresters.—The requirement that method (2) or (3) should always be used in combination with method (1) is included because quite often the lightning arrester is temporarily disconnected for inspection, overhauling, maintenance, etc., and it is desirable to have something to act as a last line of defense.

Method 2—Horn-Gap.—Quite often it is more convenient to use a gap to limit impulse voltages rather than maintaining average line insulation for a distance of one-half mile. This gap is sometimes in the form of spoons, or blunt points, mounted separately from the insulator string. Also, quite often the gap is formed by fastening guard rings or arcing horns to each end of an insulator string, using the insulators as a method of support. All these gaps as well as needle-gaps have practically the same 60-cycle and impulse arc-over characteristics for the same settings.

The gap impulse arc-over values are roughly 10 per cent less than the insulator impulse arc-over values. The reason for this is that except for a direct stroke of lightning at the transformer bank, the half-mile of reduced line insulation should provide better protection than a single gap having the same impulse voltage arc-over, because a wave coming in over the half-mile of normal line insulation will usually be attenuated more than 10 per cent by the time it reaches the station. By this is meant that if a wave comes along whose maximum value is just under the arc-over of the first insulator string, or if it arcs over the first insulation string by the time it reaches the transformer, one-half mile away, its maximum value has decreased at least 10 per cent below the value it had when passing the first insulator. Then, too, the one-half mile of normal line has several earthed points, whereas a gas has only one. This should contribute to a little better protection.

It will be noted that the 60-cycle dry flashover values given in Table II are less than the 60-cycle dry flashover voltages of line insulators given in Table I by more than 10 per cent. This is because the impulse ratio of gaps is from 20 to 25 per cent greater than the impulse ratio of suspension insulator strings. Hence, for a gap to have, say, a 10 per cent less impulse arc-over the 60-cycle arc-over must be from 30 to 35 per cent less than that of an insulator string.

Method 3—The 60-cycle flashover voltage values given in Table I represent even numbers of disks spaced 5¾ in. (14.6 cm.) apart. Consequently, these voltage steps are not in all cases proportional to the circuit voltage steps. The 60-cycle values which correspond in steps to the circuit voltages, ignoring whether or not they represent even numbers of disks, would be about as shown in Table III.

TABLE III

Rated Circuit, Kv.	Trans. 60-Cycle Test Voltage—Kv. r. m. s.	Insulator 60-Cycle Dry Flashover—Kv. r. m. s.
69	139	250
92	185	315
115	231	385
138	277	450
161	323	520
196	393	625
230	461	725

The length of the insulator strings corresponding to these voltages would be as given in Table IV.

TABLE IV

Circuit, Kv.	Length of Insulator String—Inches	Cm.
69	23	57.5
92	31	78.8
115	39	99.6
138	46	117
161	55	140
196	68	173
230	80	203

From the above it will be noted that the length of the string in inches is roughly one-third the rated circuit voltage in kv.

Where insulator disks have a spacing different from 5¾ in. (14.6 cm.), it is felt that values corresponding to the above, or as near as can be obtained with even numbers of disks, would be the more correct values to use rather than those given in Table I.

Developments Recorded at Toronto

THE A.I.E.E. summer convention at Toronto, June 23-27, bristled with an unusually large number of papers on widely diversified subjects. The symposium on system insulation co-ordination has been condensed in the preceding pages. Outstanding points in the other papers are abstracted below. The report of the non-technical events appeared in the news section of the June 28 issue

Machinery and Line Apparatus

INSULATION in generator windings is more difficult to protect against damage by surge voltage than transformer windings. Slot space is limited, padding of end turns is impracticable and resort to oil has only limited possibilities. With the trend toward direct connection of machines to line the problem has become important. Lightning protection adequate for transformers has proved inadequate for the machines. The steep wave fronts break down the insulation between turns rather than from winding to ground; the line lightning arrester has little effect on the steepness of the wave front, being more effective in limiting the voltage-to-ground value of the surge.

Shunting the windings

The paper by Fielder and Beck described an investigation of the behavior of surges in machine windings. One-half-microsecond, 2-microsecond and 12-microsecond waves were employed. The worst stress found was 80 per cent of the applied ½ microsecond crest, across the first coil; in 0.2 microsecond it had fallen to 60 per cent. The 2-microsecond wave gave an initial stress of 40 per cent; the 12-microsecond gave 20 per cent.

Observation was then made of the effect of shunting sections of the winding with condensers varying from 0.004 microfarad across the first coil, 0.004 across the first three and 0.002 across the first five. The stress between coils was less than 25 per cent of the surge.

Tests were also made with small arrester units across the entering coils to absorb the energy above breakdown voltage. Advantageous application of the arresters reduced the stress to 20 per cent of the surge. Control of the surge before entering the machine can be effected by using a lightning arrester with gap in series to ground, followed by a choke in the line and a condenser from terminal to ground, constituting a surge trap.

The methods available for protecting against surge breakdown when rotating machines are connected to overhead circuits are:

1. Insulating transformer.
2. Trap circuits of inductance and capacitance (most feasible).
3. Shunting capacitances plus arresters to ground.
4. Shunting coils by arresters.
5. Arresters from terminals to ground.
6. Inserting long cable lead to attenuate surge.
7. Shielding windings plus arresters to ground (expensive).

Behavior of surges in machine windings

One of the fundamental reasons why these transient surges cause so much trouble in electrical apparatus is because they require a definite time to travel a given distance. On an open line a surge travels at the velocity of light, which accounts for the fact that while one point on the line may be at normal line potential at a given instant, another point only a short distance away may be at 100,000 volts at the same instant. In machine windings where these circuits are concentrated in a frame of iron the two points in question may be electrically some distance apart, while physically there may be only an inch or less insulation between them.

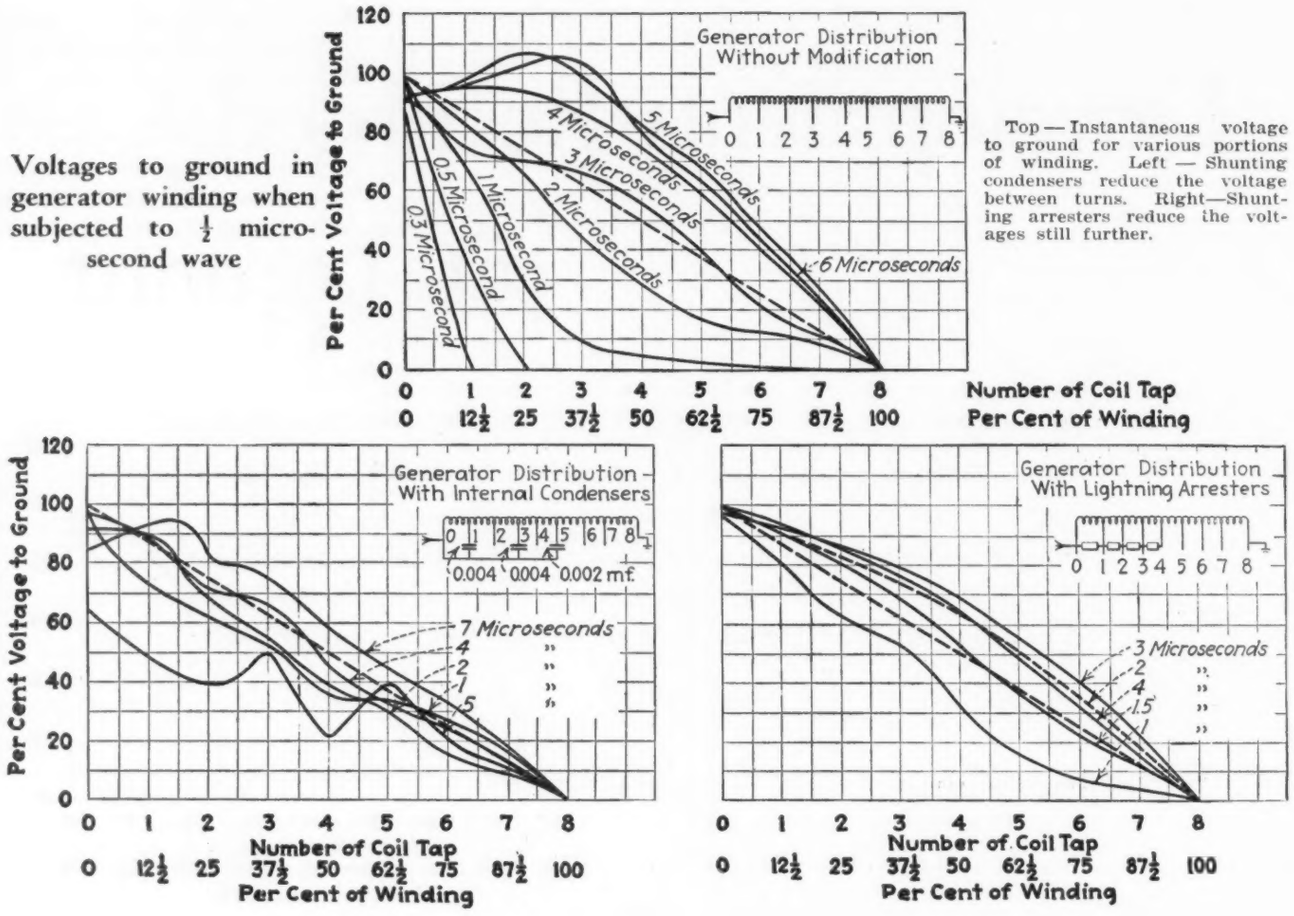
An oscillographic study of the transient oscillations in machine windings was presented by E. W. Boehne and revealed the following facts:

1. That machine windings subjected to transient surges function as finite transmission lines, of several miles in length, obeying the natural laws of reflection and propagation of surges on an open line.
2. That due to reflections at open neutrals the maximum voltage to ground in a machine winding due to a unidirectional surge is double the maximum arrester voltage.
3. That the surge impedance of machine winding tested is in the neighborhood of 600 to 1,000 ohms, while the velocity of propagation of the waves is in the neighborhood of 10,000 miles per second in the slot portions.

The following conclusions regarding protective equipment were reached:

1. That the lightning arrester is the most effective protective unit now available for the protection of machine windings. However, it only limits the magnitude of the wave which enters the ma-

Voltages to ground in generator winding when subjected to ½ microsecond wave



Top — Instantaneous voltage to ground for various portions of winding. Left — Shunting condensers reduce the voltage between turns. Right—Shunting arresters reduce the voltages still further.

chine winding and cannot control the oscillations within the winding. It does not affect the front of the wave below arrester breakdown.

2. Neutral impedance when used can be made of thyrite and effectively an open neutral during normal operation and yet afford the necessary additional protection in case of a dangerous surge.

3. Capacitors in parallel with the lightning arrester afford adequate protection for the insulation between turns of machine windings. They also provide protection for the insulation to ground of machine windings by reducing internal oscillations in cases where the neutral is open. In this respect they may even be designed to eliminate the oscillations in short open neutral windings.

4. The principles of shielding which have proved successful in protecting transformers may also be applied to generator windings.

5. For the adequate protection of large units connected directly to the line and with neutral open, some protector in addition to lightning arresters is necessary in order to insure that the internal voltages to ground will not exceed the arrester voltage and to protect adequately the insulation between turns.

Automatic Substations and Supervisory Control

UP TO a year ago only four of the five plants of the Carnegie Steel Company were electrically connected and these by a pair of 6.6-kv., 500,000-circ.mil circuits; voltage drop was excessive and interchange economies could not be realized. The paper by R. J. Harry described the reasons for adopting 44 kv. and No. 4/0 copper for the new system, the largest unit of which is 15,000 kw. Continuity of service is of prime importance in the operation of steel mills, therefore adequate but simple relaying was installed to give selectivity and reactors are relied on to assist in localization of the disturbance.

At the new structural mills an automatic station comprises three 1,500-kw. motor-generator sets at 500 r.p.m., the object being to minimize operating costs.

The substation is equipped with the following features:

1. Individual, truck-mounted, line-starting and running oil circuit breakers and starting auto-transformers are provided for each motor-generator set and one common cell housing for the necessary potential transformers is provided for all sets.

2. The normal d.c. control is taken from a constant source.

3. Push buttons are used to start all units.

4. After the unit has attained synchronous speed, a three-element regulator balances the generator voltage against line voltage and then connects the generator to the bus. The regulator then operates to maintain constant voltage on the d.c. bus. A load-limiting element regulates the load that can be taken from the generator.

5. The d.c. feeders open only on short circuit and reclose automatically after a suitable time element and the removal of fault.

6. Equipment is installed to protect against:

(a) Single and reversed phase starting; (b) a.c. undervoltage; (c) a.c. overload; (d) field failure; (e) wrong

polarity; (f) reverse power; (g) overheated motor winding; (h) hot bearings; (i) d.c. and a.c. ground protection; (j) overspeed; (k) d.-c. overload; (l) overheated starting compensator; (m) overheated generator windings; (n) undervoltage connection to d.c. bus.

The results obtained from more than four years of operation have been entirely satisfactory and we do not in any way regret the decision in favor of the automatic equipment. To date, no automatic features have been discontinued and no failures or emergencies have made necessary the installation of additional protective or automatic equipment.

Automatic mercury-arc rectifier railway substation

The principal reasons for the Union Railway Company's choice of a mercury-arc rectifier were stated by W. E. Gutzwiller and O. Naef to be as follows:

A 1,000-kw. rectifier set could easily be installed in an available corner space in the substation, while considerably less rotary converter capacity could have been accommodated in the same space.

While all the converting equipment of the Union Railway is of the 25-cycle type, 60-cycle converting apparatus had to be provided for this new substation, as only 60-cycle power was available then. Inasmuch as it was questionable, however, whether 25- or 60-cycle equipment would be used to greater advantage at some future time, it was highly desirable to provide the new converting equipment for operation on 25 and 60 cycles. Here again the mercury-arc rectifier proved to be the ideal apparatus, since it is not affected by the frequency of the supply system. The rectifier transformer, of course, had to be designed for operation on both frequencies.

Since the space in the substation had to be rented from the power company, and also in view of the expiration of the power contract, it was desirable to install the new equipment at a minimum cost. In this respect the mercury-arc rectifier also met all requirements, as it needs no special foundation; it could be set on the existing substation floor without any reinforcement. The rectifier required no ventilating ducts nor openings in the walls or roof for ventilation, such as is the case with a rotary converter, as practically all its losses are carried away by water.

Due to the stationary character of a rectifier, automatic and remote control is very simple and the costs of the control apparatus are low. Due to the simplicity of the control, only very few conduits for control wiring had to be provided. The conduits, as well as all the low-voltage power cables, could be installed overhead, thus obviating any changes whatsoever in the building structure. Remote control from West Farms substation, approximately 3 miles away, could easily be provided without much extra expense. Only eight control wires were required for remote control and indication.

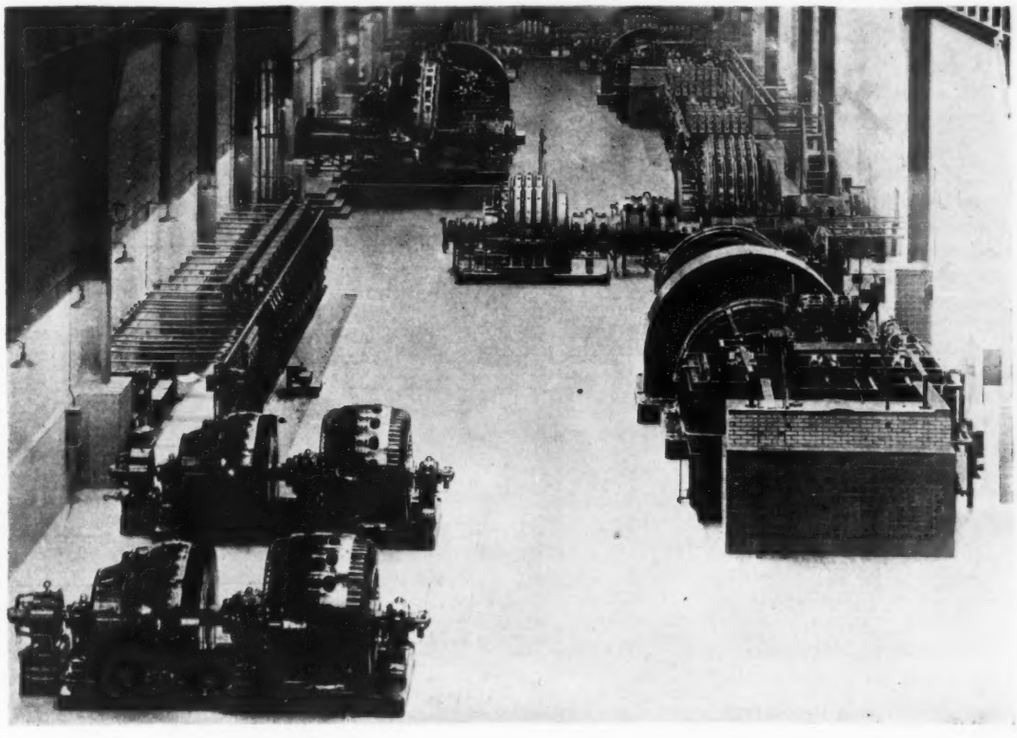
The installation shows that a rectifier can, without too much complication, be provided for automatic and remote control, that it can be installed in a very limited space without any changes to existing building and floor. Furthermore, the rectifier can be provided for operation on 25 and 60 cycles, where power at both frequencies is available, or may be considered in the future if circumstances change.

Telemetering based on transmitted frequency

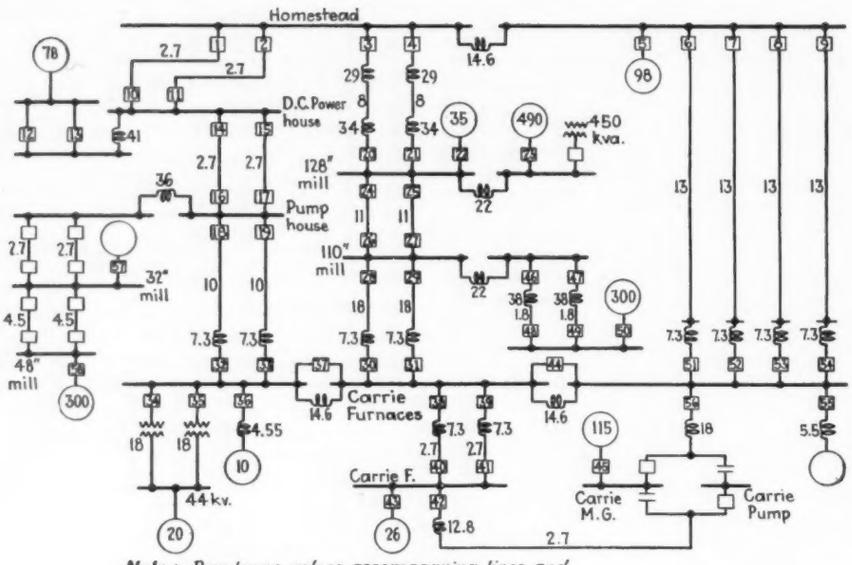
A new system of transmitting meter indications was described by A. S. Fitzgerald and is based on the transmission of frequencies varied to represent the changing values to which the meters respond. It is founded upon the superiority of frequency over voltage, current or impulses in the matter of preserving its identity over unlimited distances, with uncertain channel impedance, likelihood of attenuation and inductive interference. A small sector air condenser is attached to the meter movement and the condenser position determines the frequency of an oscillator. This relatively low frequency creates beat frequencies in conjunction with a high frequency of fixed value from a supplementary oscillator and the beat frequency actuates the indicating device at the remote point.

The advantages claimed are as follows:

1. Accuracy not affected by resistance or leakage of conductors.
2. No moving parts other than meter movements.
3. Continuous indication given all the



Automatic station housed with seven main - roll - drive motors and their auxiliaries



Note:—*Reactance values accompanying lines and apparatus are on 22,600 kva. base*

Loop system at Homestead Steel Works

Oil circuit breakers provided to short-circuit reactors when desired.

time. Follows all fluctuations registered by transmitting instrument.

4. Can readily be transmitted over power lines by means of carrier current or by radio. Accuracy not affected by signal strength.

5. No synchronous power required.

6. It is not limited to the telemetering of electrical quantities, but may readily be applied to any deflection instrument as, for instance, steam pressure, water level, temperature, etc.

7. Does not require instruments, either for transmitting or receiving, of unconventional type. No follower mechanisms necessary.

8. It is equally suitable for the telemetering of single or multiple indications.

Two-wire supervisory control system

R. J. Wensley and W. M. Donovan described an improved supervisory control and remote metering system which operates over two line wires. Practically any operation can be performed by means of the visicode supervisory control equipment, which does not require the simultaneous use of more than two wires between the local station and the remote station. We may close and trip a circuit breaker or similar switching device, raise and lower the voltage of a generator by means of a motor-operated field rheostat, control the operation of a voltage regulator, control the gate opening on a waterwheel generator, and many other similar functions. We may also give the indications associated with these various control operations, and in addition, we may indicate water level and approximate load upon a machine by means of step-by-step indication.

Current-balance remote metering may be used in conjunction with the visicode supervisory control equipment, operating over the same pair of wires between the local station and the remote station. It is evident that the metering indications will necessarily be obtained selectively and that the operation of an apparatus unit cannot be obtained at the same time as a metering indication.

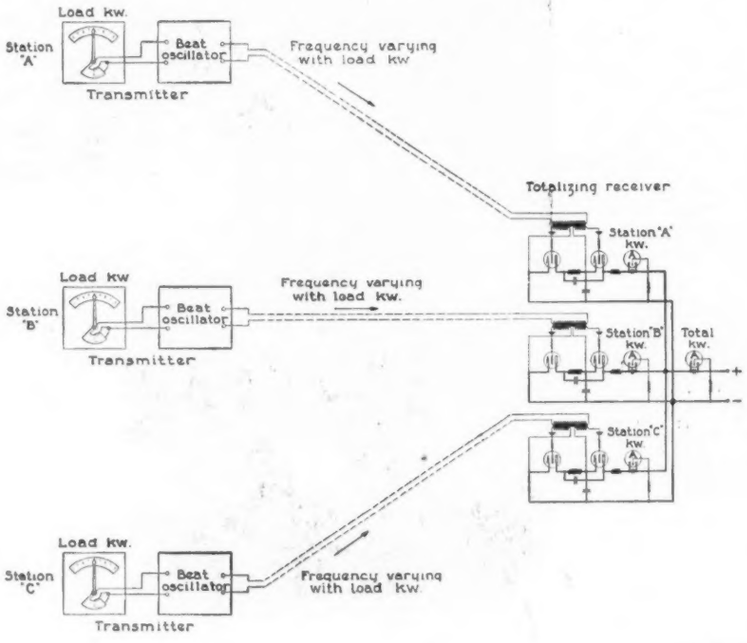
Stations of the Public Service System were first operated in parallel in 1906 and this dictated some degree of centralized control. J. T. Lawson outlined the evolution of further concentration of load control as the system grew and the ultimate consolidation of control at one office in Newark in 1926 with an automatic pilot board.

With the completion of the 132-kv. transmission system and the existing and approaching interconnections with other companies, the advantage of centralized control of system operation to this company has become more apparent.

Scheduling station loading

The 132-kv. transmission system has made it possible to schedule the loading of generating stations so as to obtain operating economy. These load schedules would be almost impossible to follow effectively were the system not controlled at a central point.

During 1929 the load dispatches issued a total of 238,986 operating orders in connection with switching changes, and of this total, only one operating mistake resulting in interruption to service is chargeable to the load dispatcher. And this one interruption occurred at a time which caused no inconvenience to the customer; in fact, was not noticed or reported. We feel justified therefore in having incurred the cost of installing and maintaining the automatic indicating system.



Frequency transmission is basis of remote and totalizing metering

Relays and Service Security

THE committee on protective devices had the following in its report about lightning protection:

For distribution circuits, experiences of several utilities indicate that the proper use of lightning arresters reduces the number of transformer failures by 50 to 90 per cent, depending on the nature of the lightning in the given locality and the nature of the equipment. In general, it has been found that the older transformers, which are usually of the smaller sizes and have smaller clearances between leads and case and over the bushings, are more susceptible to failure due to lightning than the newer transformers. One company found that transformers fifteen to twenty-five years old had a rate of failures due to lightning several times the rate for transformers made in the last five years. This company revised its specifications for 2,080 to 230/115-volt distribution transformers three years ago, improving the arrangement of the leads and increasing the flashover voltages of the leads to case and over the bushings. More than 2,000 of these transformers were in service in 1929 and not one failed due to lightning.

The Commonwealth Edison Company has continued the investigations of lightning damage on its distribution system as described in previous reports. Last year a detailed study was made of transformer locations adjacent to points where transformers failed due to lightning and the many possible factors of such adjacent points correlated in an attempt to discover the factors causing the failure to occur on the particular transformer. No new factors of importance were discovered. The previous findings were verified; that is, that old transformers and transformers with poor bushings and lead clearances are those most likely to fail. Furthermore, there appears to be a peculiar tendency for failures to occur in greater number than their fair proportion at locations where the ground resistance is less than 20 ohms. Incidentally, 99 per cent of all the ground resistance in the area studied is less than 75 ohms. This tendency is not what would be expected from laboratory tests and is not in agreement with certain data obtained on some other systems. Studies are being continued.

And on relays: The major part of the effort expended in development work during the past year or so seems to be toward the reduction of time element or the development of so-called "high-speed relays." For the past ten years the so-called "time-element relaying" has been accepted rather generally as the solution to protection problems. However, with the advent of high-voltage interconnections, the instantaneous disconnection of system faults has assumed vital importance. Where seconds have been acceptable, a few cycles are now often the maximum which can be allowed to maintain system stability. The speed of operation of circuit breakers has been reduced materially and it is obvious that relays must follow suit. Many forms of these high-speed relays are now in commercial use, some of them being entirely new developments and some of them being evolutions of existing time-element design.

It cannot be said that the use of time-element relays has been or will be entirely superseded. They will probably always be of use in some form and indispensable for certain applications, such as back-up protection. It is certain, however, that the benefits to be derived from the reduction of time in relay and breaker operation are of sufficient value to justify the general use of high-speed relays.

Interconnection relay requirements

The modern requirements for protective relays on important system interconnections were brought out in several papers, especially one by O. C. Traver and L. F. Kennedy. They pointed out that the usual methods of relaying are becoming inadequate for tie line application. The need for limiting the duration of faults on lines of major importance is unquestioned. The possibility of maintaining stability by quicker operation of protective equipment is well recognized. These considerations have resulted in the development of the high-speed relays and oil circuit breakers as steps in the over-all reduction of short-circuit duration.

Besides limiting the duration of short circuits, it is frequently necessary that the protective equipment function correctly at current values below rated load. On some important interconnections the range in capacity is such that the minimum short-circuit current is but a fraction of the full-load value. It is a requisite, therefore, that the new protective relay types and methods should give rapid, selective action, even at low current values. It is obvious that the use of cumulative or graded settings will not produce the desired results. Preferably, therefore, the relay equipment should make no attempt to operate except when a fault occurs on the circuit protected or as back-up for disorders in a contiguous line. Furthermore, excepting where the through current is limited chiefly by the impedance of the protected line alone, its absolute magnitude is of little value in determining where any particular fault exists.

Time having been excluded in the concept of our problems, and current magnitude, or any other single quantity, being too variable to be trustworthy, an immediate comparison of two or more electrical quantities is needed, as a prompt means of discriminating between good and bad. These comparisons may be listed as:

Series balance	Comparison of currents at the two ends on a circuit.
Parallel balance	Comparison of currents at one end of two parallel circuits.
Balance of dissimilar quantities	*e. g.* current and voltage.

The series balance method gives a comparison of the relative magnitude of current values at two points in the same circuit. It is the best method of obtaining selective action. This is the familiar differential protection, in which an instantaneous comparison is easily made between currents, normally equal at two points reasonably close to each other. A fault is indicated by an inequality between the two current values. For line protection, such methods involve the use of pilot wires, with their attendant expense and technical problems, in proportion to their length. Quick action is secured with simultaneous tripping of both ends of the line, for faults over its entire length.

On account of the simplicity, reliability and speed of this equipment, two similar parallel lines should be protected by balanced relays which will operate to trip one line when its current is a certain percentage above that in the other line. The percentage unbalance is chosen high enough to prevent false operation on small differences, such as may be due to variation in current transformer or transmission line characteristics, unequal mutual inductance, and similar causes. The usually accepted value is 25 per cent unbalance on outgoing lines.

Comparison of dissimilar quantities

In any circuit there is a distinct difference in the relative values of current and voltage between load and fault conditions. A relay operating on the ratio of these quantities is, therefore, valuable in indicating the occurrence and location of a fault. The ratio between voltage and current is impedance, and impedance, neglecting the fault component, is a measure of distance.

On any transmission line section the impedance is known, and if a relay having an ohmic pick-up is set at a lower value than that of the line, its operation will result only in case the section considered is at fault. Such an arrangement needs very little time delay and, therefore, approximates the methods which employ a comparison of currents in parallel circuits.

Cables, Transmission and Distribution

THERE has been discussion for many years concerning the effectiveness of cable in reducing the potential of incoming surges, and as a result considerable uncertainty has existed as to whether or not current practices are correct with regard to methods of protection, both of the cable itself and of apparatus connected to the cable.

Recognizing this problem as being of great importance to both manufacturers and operators, a joint investigation by the General Electric Company, the Consumers Power Company and the Detroit Edison Company was arranged late in the summer of 1929. The results were reported by Messrs. McEachron, Hemstreet and Seelye. Some of the conclusions reached are:

1. There was no appreciable change in wave shape with distance for the section of line used. The crest voltage of the waves was close to the critical corona voltage of the line. Hence no great attenuation of crest voltage appears and very little change in the wave front. The distance covered by measurement with sphere gaps and oscillograms was 3.7 miles.

2. Attenuation of crest voltage was small. In traveling 3.68 miles the steep wave was reduced 15.5 per cent and the medium wave was reduced 14.7 per cent.

3. High-frequency oscillations which appear on the front of a steep wave are damped as the wave travels along the line.

4. A wave having a front whose length is short compared to the time required for the voltage to build up in the cable will be less steep after passing through a cable.

5. The amount of change in wave front for a wave passing through a cable will depend on:

(a) The steepness of the wave front.

(b) The length of the crest or near crest of the wave.

(c) The length of the cable.

(d) The values of surge impedance for line and cable.

6. A wave passing through a section of cable will have its crest value reduced unless the wave has a flat top long enough to cover the time required for the cable voltage to build up by reflections to practically the crest value of the incident wave.

For a 500-ft. section of cable the crest voltage was reduced 10.8 per cent for both the steep wave and the medium wave.

For a 1,000-ft. cable the crest voltage was reduced 24 per cent for the steep wave, 23.3 per cent for the medium wave and 17 per cent for the slow wave.

7. When a wave passed into the cable the initial transmitted wave was approximately 30 per cent of the incident wave. This value is dependent on the surge impedance of both line and cable.

8. A short section of cable acts like a concentrated capacity at the open end of a line or at an intermediate point in a line, provided the length of the wave front is long when compared to the time required for the wave to be reflected through the cable. Such a cable or capacitor does not reduce the surge voltage at the connected point if the incident wave has a long flat top.

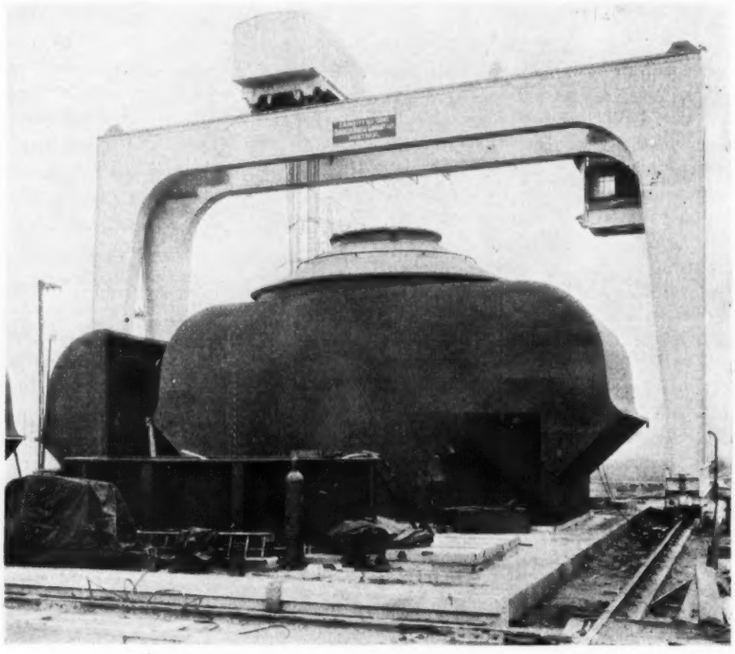
9. Short lengths of cable cannot be regarded as protective devices for the reduction of overvoltage surges with long flat tops such as often occur in service.

Buried transformers perform satisfactorily

Experiments with buried transformers were started in Toronto in 1924. C. E. Schwenger reported that this practice was especially desirable with the larger size of the 25-cycle transformer to avoid adverse comment on pole mounting in residential districts. The case is made somewhat larger and heavier than for pole mounting, size and weight being of less consequence. Breathing is prevented by means of a seal which proves tight at 10 lb. per square inch. A special buried-type oil-immersed fuse cutout has been developed having a valve for escape of blowout gases. Thirty such installations are in service in Toronto and operate at nearly their normal full load rating without exceeding permissible temperatures.

The story of the Hydro-Gatineau connection

The power requirements of the Ontario and Toronto 25-cycle systems were outlined by E. T. J. Brandon, who reported also a comprehensive record of the reasons for all the important decisions in the execution of the interconnection with the Gatineau Power Company to supply the power required in excess of the already limited output of Niagara. A survey of the Toronto load brought out the possibility of locating the 220-kv. station so as to supply the 13.2-kv. power directly for the local feeders through the medium of delta tertiary windings otherwise demanded for the circulation of harmonic currents. Windings for 110 kv. were provided for connection to the existing system. The ultimate capacity is 360,000 kva. with four incoming 220-kv. lines. The installation also comprises four 25,000-kva. outdoor synchronous condensers. Lightning arresters are omitted, protection relying on co-ordination of the system insulation (as described by G. D. Floyd in another paper). In grounding the station, special effort was made to avoid ground gradients due to



25,000-kva. outdoor condenser at Leaside

scattered faults. Teletypewriter service over the Bell system is employed for communication with the Gatineau system.

25,000-kva. outdoor condensers at Leaside

In November, 1929, the first of the 25,000-kva. vertical shaft, outdoor type synchronous condensers for the Toronto-Leaside transformer station of the Hydro-Electric Power Commission of Ontario was placed in service. Messrs. Ricker, Dunbar and Day described the installation and the factors considered in the design. Each unit includes the synchronous condenser, direct-connected exciter and separate constant-voltage pilot exciter, all on one shaft. A vertical unit could be more economically inclosed for outdoor installation than could a horizontal unit; the removal of a rotor from the stator usually presents a tedious problem with a large, high-speed horizontal unit.

To aid repairs the upper bearing bracket, or guide-bearing support, is arranged with a demountable center, only large enough to permit the crane block to pass through the hole. This arrangement permits the attachment of the crane to the shaft without the exposure of the whole top surface of the unit, as would be the case if the entire top bracket had to be removed.

In overhauling, a truck is run under the exciters, they are held with jacks while being detached, and then the truck is run out of the way. The blocking of the thrust bearing is removed and the rotor dropped by the crane onto the pit floor, thus giving access within the inclosure to both rotor and stator surfaces.

The thrust bearing is of the Kingsbury tilting shoe type. Starting and stopping are entirely automatic; in stopping, the machine is brought to rest by a combination of dynamic braking and air braking.

Television, Broadcasting, Communication

TWO-WAY television is an accomplished fact in the laboratory. To make it possible several notable advances have been made in the former technique of one-way television. The upper limit of transmission frequency has been elevated from 20,000 to 40,000 cycles to insure an image carrying unmistakably recognized traits and expressions. The intensity of the scanning beam has been reduced and the color changed to blue, less annoying to the eye and more useful to the photo-electric cells. The interior of the booth is lighted in amber tone, pleasing to the eye but a matter of indifference to the cells. Water-cooled neon lamps capable of carrying a high current provide the needed increase in beam intensity; they are argon filled for enhanced ionization. Amplification builds up the photo-electric cell voltage of 50 microvolts to 100 volts as the receiving neon lamp.

The simultaneous transmission of both images and both conversations requires eight circuits, two for the image signals, two for the voice, one for synchronizing, two for order wires and one spare. This seems to indicate that two-way television service when commercially available will have to be restricted for some time to transmission between large cities and conducted on an appointment basis.

Expansion of communication services

The expansion of the later branches of communication were recorded in the annual report of the communication committee. The extension of toll cable continued even more rapidly during 1929 than for the previous year. Approximately 3,700 miles of loaded intercity cable were added to the system, together with about 1,300 miles of short-haul toll cable, making a total of 5,000 miles for the year and a total of toll cable, both long and short haul, for the United States of about 20,000 miles. The greater part of this mileage is in the northeastern section of the country, but extensions are being made rapidly in the South and West. Continuous cable plant now extends from Bath, Me., to Charlotte, N. C., and westward over several routes as far as Iowa City, Iowa.

Recently there have been introduced in this country two methods for securing more economically the advantages of the underground cable where the rate of growth does not require the frequent placing of additional cables. In one of these methods a cable, protected by means of impregnated paper, jute and steel tape covering, is buried in the ground without conduit. In the second method a single fiber conduit is laid and the lead-covered cable is drawn into it. In both these new methods manholes are placed only at points where loading coils are to be inserted. This results in the reduction of the number of manholes as compared to previous practice from about 8 per loading section to only one.

Dial system extension

The growth of dial system service in the United States during 1929 was rapid and is represented by an increase of dial telephones of approximately 850,000, or 24.3 per cent. Approximately 21½ per cent of the total telephones in the United States are now operated on the dial basis.

The rapid extension of carrier telephone facilities throughout the United States continued during 1929. The increase in number of channel miles in service was approximately 135,000, or 57 per cent.

Tests have shown that satisfactory two-way telephony is possible between airplanes and practically any telephone connected with the United States. In several of the tests commercially satisfactory communication was maintained between an airplane here and telephone stations in Europe.

Traffic signals

There has been considerable extension of electric traffic signals. The newer devices show a decided shift toward the "New Jersey" cycle, green, amber, red, green.

In congested districts there has been a considerable increase in progressive signals. With these a vehicle starting at one end of a street protected with a green light may travel through to the end without being delayed by a red light provided speed is kept within predetermined limits.

Simultaneously there has also been a considerable increase in signals controlled by the vehicle. These are set to show green normally on the more traveled route and are reversed by vehicles running over a switch or magnet in the street.

Room noise studied

A joint study by Bell and N.E.L.A. engineers has been in progress to ascertain the range of magnitude of room noise in typical telephone locations.

On the average, room noise in residences was about 20 decibels less in magnitude than that in business locations.

The spread in the magnitudes of business room noises was about 40 db., as compared to 20 db. for residence room noises. These spreads include 90 per cent of the measurements, excluding the lowest and highest 5 per cent. The standard deviation of the measurements was about 12 db. for business noise and 6 db. for residence noise.

Room noises average 4 or 5 db. higher in summer than in winter.

In general, the magnitude of residence noise was affected to only a minor extent by the size of the town or city in which it was measured.

On the average, the frequency composition of residence noise was about the same as that of business noise. The masking effect of the noise on a tone covering the range 750-1,500 cycles was greater than that on ranges above and below this. The magnitudes of components in the lower part of the range

covered (about 250-5,000 cycles) appeared to be somewhat larger than those in the higher part of this range.

Improved broadcast program circuits

Radio broadcasting stations covering various local areas in the United States are connected together by wire circuits so that programs are delivered simultaneously to all of them. Thus, it is possible to deliver a program to the whole nation at once. About 35,000 miles of telephone circuits are now being regularly utilized for this service and about 150 radio broadcasting stations receive programs from one or more of the chains of wire circuits.

Because of the special characteristics which program transmission circuits must possess it has been necessary to develop an entirely new type of cable circuit, in which the method of placing the wires in the cables, the type of loading and all of the apparatus, including amplifiers and distortion-correcting apparatus for both amplitude and delay, differ radically from other cable circuits. The development was recently completed and a trial installation made in which wires were looped back and forth in the cables between New York and Pittsburgh so as to produce a circuit 2,200 miles in length. Tests were made on this circuit over a period of several months and very satisfactory results were obtained. They were reported by A. B. Clark and C. W. Green.

Transmission requirements

For program transmission the ideal, of course, is to provide a transmission line such that no distortion whatsoever will be caused to program material transmitted over the line, whatever be its length. Ideally also, program pick-up apparatus, radio transmitters, radio receivers and loudspeakers should be such that the program delivered from the loudspeaker should sound exactly like the original program delivered to a direct listener in the best location. To meet this ideal, however, would require that the whole audible range of frequencies, extending from about 20 to 20,000 cycles, and a tremendously wide range of volumes representing power differences of more than a million-fold be handled without any distortion whatsoever.

These general considerations have led to the adoption of the following as practical standards of performance for the new cable system:

1. Frequency range to be transmitted without material distortion—about 50 to 80,000 cycles.

2. Volume range to be transmitted without material interference from extraneous line noise—about 40 db., which corresponds to an energy range of 10,000 to 1.

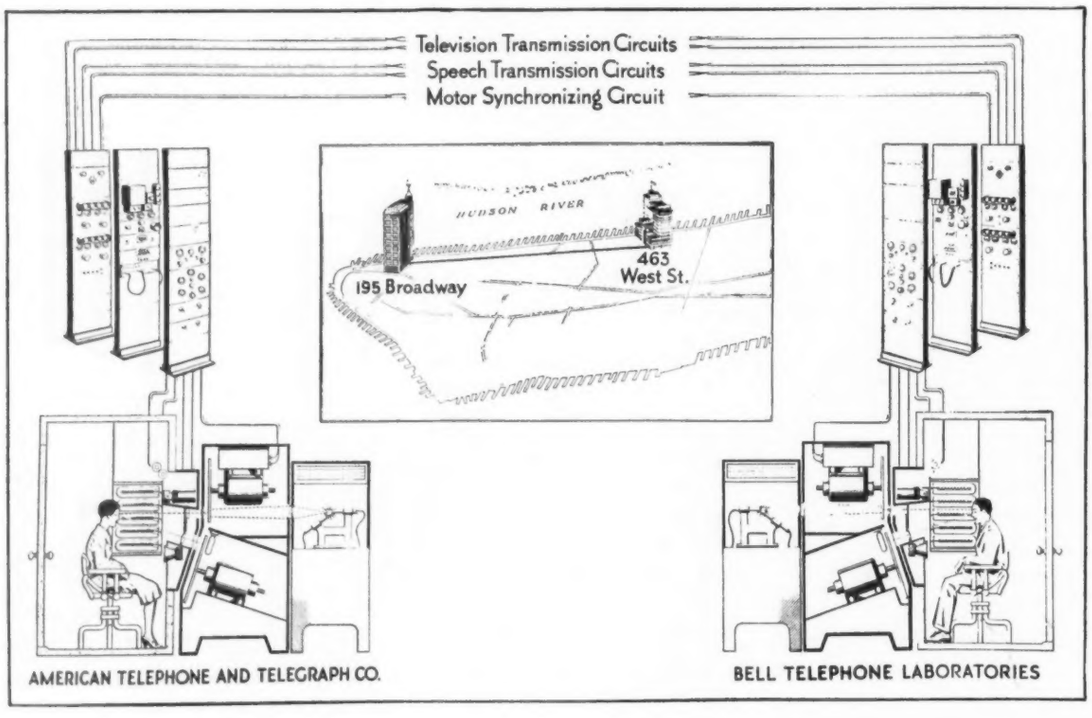
The new circuit set-up

The new transmission paths are provided by means of No. 16 B. & S. gage non-phantomed pairs having a capacitance of 0.062 mfd. per mile. These pairs are loaded with 22-milhenry inductance coils spaced 3,000 ft. apart. Present long-distance message telephone circuits in cable have loading coils spaced 6,000 ft. apart. The nominal cut-off frequency of the new circuit is about 11,000 cycles, permitting effective transmission of a frequency band extending up to about 8,000 cycles.

New amplifiers, attenuation equalizers, automatic devices to overcome effects of varying cable temperature and delay equalizers have rounded out the improved circuit facilities. A measurement of the transmission loss of the 2,200-mile test length of B-22-N cable circuit indicated that over the range from 35 cycles to 8,000 cycles the transmission loss was practically the same at all frequencies, departing about ± 2 db.

Range of volume

A favorably seated listener to a high-grade orchestra is treated to a wide range of volumes. Opinions differ as to just how wide a volume range can be appreciated by such a listener, but it seems certain that it is at least 60 db., corresponding to a power range of one million to one. The human ear can hear volume ranges in excess of 100 db., corresponding to a power range of ten billion to one. For loudspeaker reproduction it has been found that a room must be particularly quiet in order to be able to appreciate a volume range of 60 db. Rooms in three-quarters of the usual residences are probably too noisy for a volume range as great as this to be appreciated. a 40-db. volume range, corresponding to a power range of ten thousand to one, can be appreciated in most rooms where radio listening is done and is quite satisfactory for most musical selections.



Experimental television system between two Manhattan laboratories

Mercury-Vapor Unit a Commercial Success

FOR seven years the engineers of the Hartford Electric Light and General Electric companies have labored co-operatively to demonstrate the potentialities of the mercury-vapor cycle for the more economical operation of generating equipment. Experiments were numerous; changes not infrequent; rumors developed at intervals.

NOW the organization which displayed such pioneering courage and faith in Dr. Emmet's hopeful dream is willing to say that the process has been proved conclusively to be sound in both theory and practice; 10,000 B.t.u. per kilowatt-hour is the efficiency now obtained.

By T. H. SOREN

Vice-President Hartford Electric Light Company, Hartford, Conn.

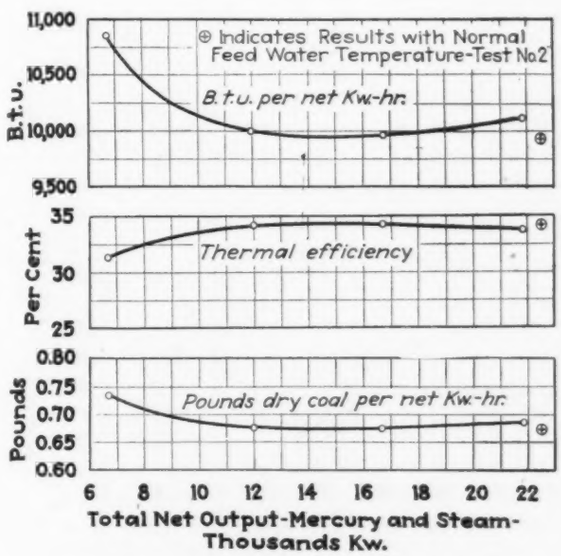
EXPERIENCE with the mercury-vapor process devised by Dr. W. L. R. Emmet of the General Electric Company, as installed at the South Meadow station of the Hartford Electric Light Company, proves conclusively that this method of power generation is entirely sound both in theory and practice. Electrical energy is being commercially produced by this unit upon a fuel consumption of 0.7 lb. of first-class bituminous coal per net kilowatt-hour. This is equivalent to about 10,000 B.t.u.s per kilowatt-hour, and these results indicate that in less than 3½ years the economies of the unit will wipe out the estimated excess investment over the cost of a complete 10,000 kw. addition to the existing steam plant and the cost of a further boiler addition capable of furnishing steam for an additional 10,000 kw. The final installation cost was considerably below the estimate.

This pioneer commercial installation consists of a mercury boiler, turbine and accessory equipment which delivers 10,000 kw. in electrical energy at the station busbars and also delivers 130,000 lb. of steam per hour at 275 lb. pressure and 700 deg. temperature at the boiler room header. The steam is generated by condensing the mercury-vapor exhaust from the turbine.

The original installation of this development was made at the Dutch Point station in 1923. This included a mercury turbo-generator which delivered 1,800 kw. to the busbars and a condenser producing 40,000 lb. of steam per hour at 200 lb. pressure and 560 deg. temperature.

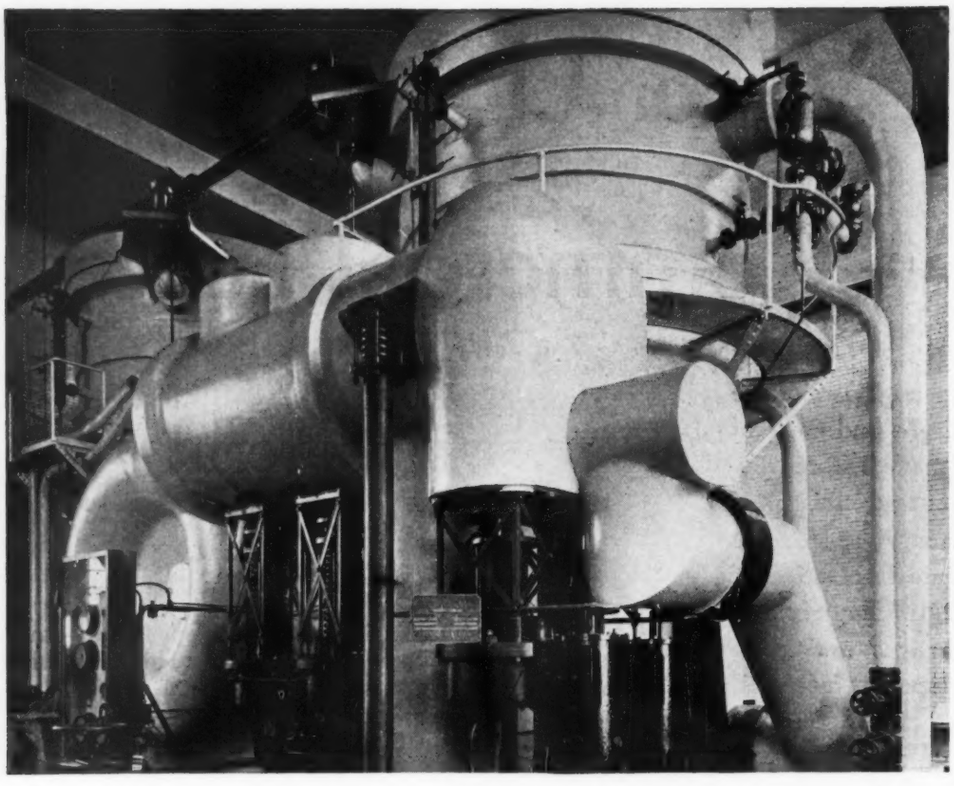
Two experimental boilers were used at Dutch Point. The first proved the entire practicability of the mercury cycle and demonstrated that the predicted economy was obtainable, but it was not commercially practical. After several months' operation the second boiler was developed.

The second boiler was of the drop tube type and was successfully operated for several years. From experience with this boiler, a new boiler of commercial size was developed, similar in all essentials to its predecessor.



Performance of mercury-vapor unit

Combined results of generation by mercury unit direct and by steam produced, assuming steam utilization at the rate of 10 lbs. per net kw.-hr. (South Meadow Station)



Mercury-vapor turbine, valve, relief pipe and controls

The new unit was installed in the South Meadow station in 1928.

Defective workmanship led to the failure of a tube in this first South Meadow boiler. The design required extremely accurate workmanship to insure safe operation. Several months, therefore, were required to redesign and manufacture new tubes more rugged in construction and better fitted for boiler practice. The retubed boiler is now operated at its full rated capacity. Its operation is extremely simple and of great flexibility.

Six years without mercurial poisoning

The experimental installation at Dutch Point was built and operated on the assumption that there was no hazard from mercurial poisoning to the operators. The art of welding had not then advanced to the present degree of accuracy and reliability and an occasional leak would develop. At first no special precautions were taken during the construction and overhauling of the apparatus. Several men were affected by mercury taken into the system through the mouth. The men recovered very shortly. The remedy was light exercise in the open air. In the worst case, the man recovered and was entirely comfortable within four days, but was kept under observation for an additional week. There has never been a case of chronic poisoning which produces salivation, etc.

An intensive study was made of the whole situation; very simple precautions were taken to protect the operators and repair men, and there have been no cases of mercurial poisoning for the last six years.

The header of the second boiler at Dutch Point was of insufficient strength and opened up. The flue and stack temperatures in this installation were high and a considerable amount of mercury was carried out through the stack about the station yard. No inconvenience was suffered by any of the employees about the plant, and the opening, though considerable, was similar to the opening of the header under hydrostatic pressure. Men standing immediately in front of the boiler were not aware of the accident until they noted the falling off of the mercury level in the boiler. Owing to the low specific heat of mercury, there was no disruption or other violent action from the failure, and no injury to the settings resulted.

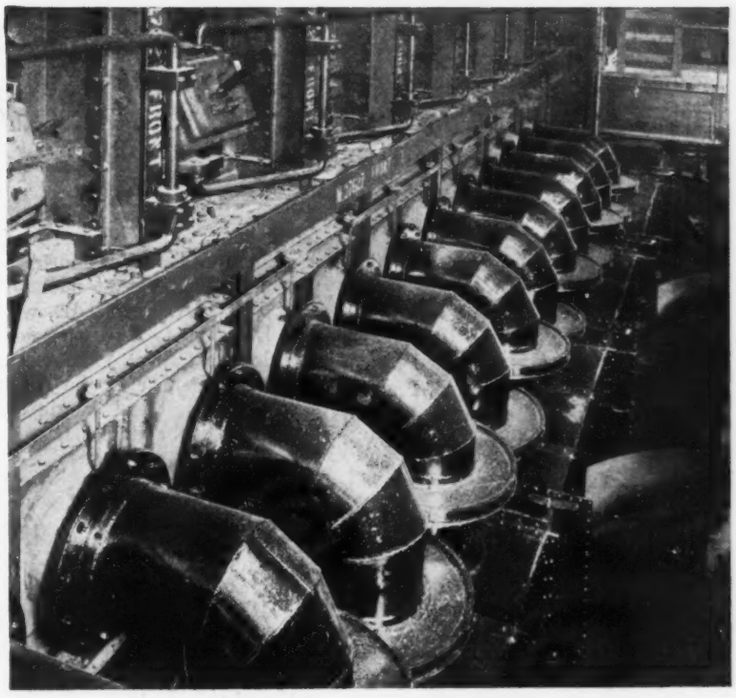
The commercial installation at South Meadow has taken advantage of the Dutch Point experience and there is no possibility of the operators coming in contact with mercury in any form. Precautions are taken in cases of repair and maintenance work which have entirely eliminated any hazard to employees.

During the operation of the experimental plant at Dutch Point there was a loss of mercury from two causes: First, more or less carelessness and lack of experience, and, second, the failure of the header mentioned above. The amount of mercury used in the experimental installation was about 20 tons. The total loss from all causes was less than 2 tons over the complete period of operation and reconstruction. The principal loss was the result of the failure of the header mentioned above.

At South Meadow one of the tubes in the boiler failed, due to faulty workmanship. A considerable amount of mercury was released to the furnace. The pulverized coal supply was immediately shut off. As mercury condenses at atmospheric pressure at approximately 675 deg. F. a very large percentage of escaped mercury was recovered from the flues, stack and ash pit. The temperature at the base of the stack is approximately 300 deg. F., so that a very considerable amount of the mercury condensed before it reached the top of the stack. There was no evidence of any considerable amount of mercury about the station yard or buildings. With this exception, there has been no loss of mercury in the present installation.

In the case of leakage about the piping or turbine, all mercury is recovered, and in case of tube failure a large percentage of the escaped mercury will be recovered.

The mercury turbo-generator room is entirely sep-



Upper air ducts and expansion joints

Unusual construction was developed for the mercury-vapor settings. This view is along the front of the boiler. Explosion doors appear in the upper part of the figure.

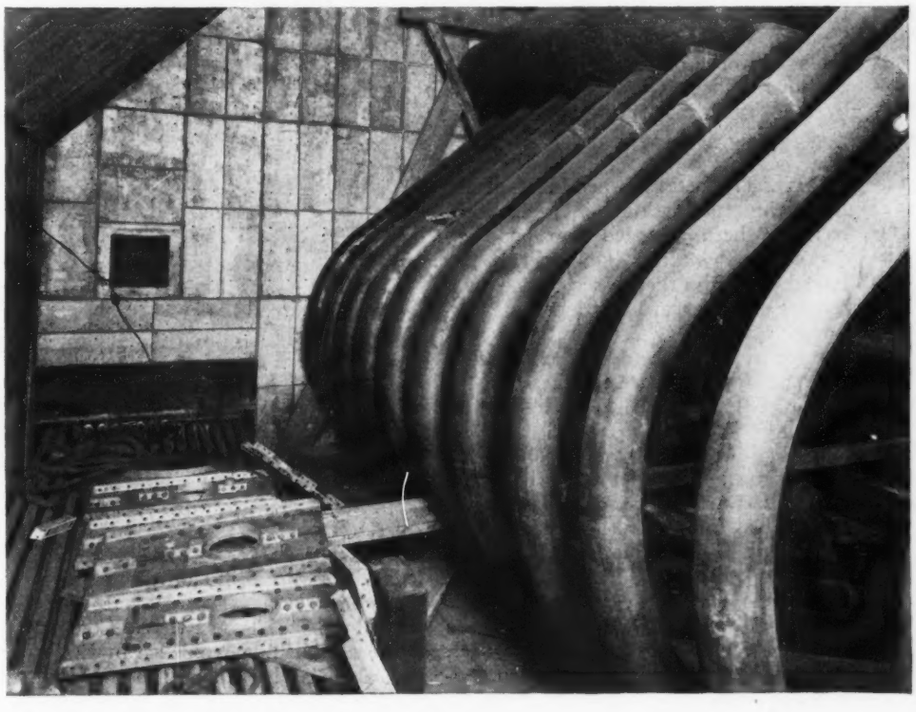
arated from the other parts of the operating floor and the boiler room. One man and a helper per shift were added to the station force to be present in this room to watch the operation. The control of the load is by the boiler room operators varying the pressure on the mercury boiler.

Mechanical problems offered chief difficulty

The entire commercial development of this cycle has been carried on at Hartford, and due to the novelty of the process, a number of obstacles have been met and overcome. The use of mercury in the process has caused no difficulty whatsoever. It is absolutely stable and no interference has ever been experienced from oxidation or other causes with its use. The difficulties met have been in the mechanical handling of mercury. Owing to the cost and weight of mercury, the major objective has been the development of equipment using a minimum amount of mercury in the process. The boiler, piping, valve bodies, condenser, turbine casing, etc., are all low-carbon steel.

The installation has been in regular operation since February 4, 1930, and is used similar to our regular steam equipment. The load is reduced to 1,000 kw. at night and the unit is shut down from Saturday noon to Monday morning, when hydro-electric energy is available through interconnection. Under these conditions the equipment as operated has turned out a total to date of 40,000,000 kw.-hr. net, at a coal rate of 0.7 lb. per kilowatt-hour. This includes the electrical energy delivered by the mercury turbine to the station bus, plus the use of steam in the steam turbine units at the station.

Experience at Hartford shows that the present coal rate will be reduced by further development and that a considerably higher capacity can be produced from approximately the same investment cost. The result is that the initial cost of this system will not be materially in excess of the cost of equivalent station capacity, plus steam capacity.



Mercury piping and economizer tubes in boiler setting

Men of the Industry

P. M. Downing New Vice-President of N.E.L.A.

PAUL M. DOWNING, first vice-president and general manager of the Pacific Gas & Electric Company, was elected fourth vice-president of the National Electric Light Association at the convention held recently in San Francisco. Mr. Down-

ing's entire professional career has been spent on the Pacific Coast, where he has held a position of prominence, especially in public utility circles, for a number of years.

His first connection in the light and power field was with the Tacoma (Wash.) Light & Power Company as dynamo tender and affiliations followed with the Market Street Railway Company, San Francisco; with the municipal plant at Blue Lake City, Calif.; the Stanley Electrical Manufacturing Company, the Standard Consolidated Mining Company, Bodie, Calif.; the Colusa Gas & Electric Company, Colusa, and the Bay Counties Power Company, San Francisco.

Thus when Mr. Downing entered the employ of the Pacific Gas & Electric Company in 1903 he already had an excellent background of practical engineering experience. Serving as operating engineer, engineer of operation and maintenance, chief engineer of the electric department, he was appointed vice-president of the company in charge of electrical operation early in 1920, and later the duties of supervision of electrical construction were added. About a year ago he was named first vice-president and general manager to succeed Frank A. Leach, Jr., who retired. Mr. Downing is a past-president of the Pacific Coast Electrical Association and an active member of the American Institute of Electrical Engineers and of other technical societies.

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Mr. Edison Receives John Scott Medal

IN THE PRESENCE of a distinguished group of people Thomas A. Edison received the John Scott medal and an accompanying award of $1,000 on June 25 at his laboratory in West Orange, N. J. The award was made in recognition of Mr. Edison's outstanding contributions to science. Associate Supreme Court Justice Owen J. Roberts, who made the presentation, recounted the history of the award and paid tribute to the achievements of the great inventor. In responding Mr. Edison expressed his gratitude for the distinguished honor bestowed upon him.

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IRVING E. MOULTROP, chief engineer of the Edison Electric Illuminating Company of Boston, and NORMAN R. GIBSON, vice-president of the Niagara Falls Power Company, were recently awarded Elliott Cresson gold medals by the Franklin Institute.

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KARL T. COMPTON, president of the Massachusetts Institute of Technology, has just been awarded two honorary degrees. Princeton University conferred upon him the degree of doctor of science and Harvard the degree of doctor of laws. Dr. Compton was cited for his research work on the electric arc and for his investigations in the general field of electrical discharge.

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FRANKLIN M. FERNALD, vice-president, treasurer and general manager of the Central Connecticut Power & Light Company, East Hampton, Conn., has resigned because of ill health. ABEL REYNOLDS, formerly secretary to the president, Arthur B. Lisle, has been elected vice-president and treasurer. ROLAND CHASE has been appointed general manager.

W. R. Bell Appointed to Executive Position in Louisiana

W. R. BELL, since 1926 general superintendent of the El Paso Electric Company, El Paso, Tex., has been made general superintendent of the Baton Rouge Electric Company and the Louisiana Steam Products Company, Baton Rouge, La. He will be succeeded in El Paso by H. C. Leonard, who has been in charge of the electrical department of the Virginia Electric & Power Company, Richmond.

Mr. Bell has been employed by companies operating under the executive management of Stone & Webster, Inc., since 1906. He began in the accounting department of the Paducah Electric Company, working during vacations while attending college. Following his graduation from Rose Polytechnic Institute, Terre Haute, Ind., as electrical engineer, Mr. Bell accepted the position of assistant superintendent of the Baton Rouge Electric Company, later being made sales manager. Subsequently he was sent to Haverhill, Mass., as sales manager of the Haverhill Gas Light Company. In August, 1924, Mr. Bell was sent to El Paso as sales manager. His excellent record as head of the sales department led to his selection as general superintendent in 1926, and

since that time Mr. Bell has been closely identified with some of the most important developments that were undertaken by the El Paso Electric Company. Since establishing residence in El Paso Mr. Bell has been active in community work.

C. L. Harrod Assigned to Utility Managership

CLIFFORD L. HARROD, industrial commissioner and general manager of the Indianapolis Chamber of Commerce since February, 1927, has been appointed general manager of the Indianapolis Power & Light Company. As general manager of the public utility company, Mr. Harrod will fill one of the offices held by Norman A. Perry since early in 1927, when the Indianapolis Power & Light Company was formed by a consolidation of two competing companies. Mr. Perry will continue in the office of president of the company, but will turn over the duties of general manager to Mr. Harrod. Mr. Harrod is a graduate in electrical engineering of Purdue University. Before making his connection with the Chamber of Commerce as head of its industrial commission, he was consulting electrical engineer for the Indiana Coal Operators' Association.

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C. H. Hardesty Heads East Central Division

CHARLES HOWARD HARDESTY, new president of the East Central Division of the National Electric Light Association, entered the electric utility business by way of the traction field. After his graduation from West Virginia University in 1914 he was engaged in construction work for the Western Maryland Railway until 1917, when he entered the purchasing department of the Monongahela Valley Traction Com-

pany, where he rose to the position of general traffic manager. In 1925 he became manager of the Parkersburg-Marietta division of this company, which by that time had changed its name to the Monongahela West Penn Public Service Company. In 1927 he was named assistant to the president and in 1929 vice-president in charge of electrical production and sales.

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E. R. Ernsberger Named President of New Holding Company

EARL R. ERNSBERGER, who has been prominently identified with the public utility industry in the Southwest, has recently assumed the duties of president

of the Western Service Corporation, a holding company organized to operate electric and gas utilities, as well as a radio wholesaling and oil business, with headquarters in Oklahoma City. It was Mr. Ernsberger who took the Southwestern Light & Power Company and built it from an electric and gas utility serving seven cities to a property covering southwestern Oklahoma in a network serving 100 cities. A year and a half ago he resigned as president to devote his time to his personal interests.

A graduate civil engineer, Mr. Ernsberger first engaged in railroad engineering before joining the Mount Hood Railway & Power Company of Portland, Ore., as chief engineer and general manager. When this property was acquired by the Portland Railway & Power Company he transferred his interests to the Charles City Western Railway Company, Charles City, Iowa, as vice-president and general manager. It was in 1922 that he affiliated himself with the utility industry in Oklahoma, in which he had participated actively since that time until his resignation in 1929.

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HENRY I. HARRIMAN, chairman of the board of directors of the New England Power Association, has been made the recipient of the honorary degree of doctor of laws by Wesleyan University.

OBITUARY

ROBERT BREMMER, sales manager in the Portland (Ore.) office of the General Electric Supply Corporation, died May 8 in that city.

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FRANK BUCHANAN, 68, superintendent of the headlight division of the Crouse-Hinds Company, died recently at his home in Syracuse, N. Y., following a short illness. He was a native of Piqua, Ohio, and had resided in Syracuse 30 years.

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ALBERT J. FRANCIS of Fort Wayne, Ind., manager of the fractional-horsepower motor section of the industrial department of the General Electric Company, died June 17. Mr. Francis, who was born in Lyons, N. Y., December 8, 1875, was made manager of the section named in 1916.

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FRED D. LYON, formerly superintendent of construction for McClellan & Junkersfeld, died at San Diego, Cal., May 30. McClellan & Junkersfeld were the builders of the Cahokia plant of the Union Electric Light & Power Company of St. Louis and Mr. Lyon had the responsibility of carrying out the intricate details of that project from the beginning of building operations in 1922. He was a member of the A.I.E.E.

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ERIK G. SOHLBERG, designing engineer in the construction engineering department of the General Electric Company, Schenectady, died June 13 following an attack of appendicitis. Graduated from Norrkoping College, Sweden, in 1900 with the degree of M.E., Mr. Sohlberg went to England in 1902 to become associated with the British Thomson-Houston Company. In 1905 he entered the employ of the General Electric Company in this country and in 1912 became designing engineer in the construction engineering department, specializing in power-plant and substation design.

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ALVIN E. BLISS, who was connected with the Tenney interests for a number of years, died May 6. A native of Brookline, Mass., Mr. Bliss helped to organize the Malden Electric Company, of which he was a leading figure for almost fifty years. For several years past and at the time of his death he held the position of safety engineer of Charles H. Tenney & Company. The record of Mr. Bliss as a public official is not to be disregarded. He served for two terms in the Malden City Council, in the Massachusetts House of Representatives and in the State Senate and held the chairmanship of many important committees. At the time of his death he was a member of the Governor's Council.

Financial and Statistical News

AT CLOSING, the securities market last week had a better tone than characterized its early activities, when the dullness of business and trade was reflected in trading operations. Even though stocks fluctuated irregularly, there was an undertone of strength.

——THE CURRENT WEEK was ushered in with a marked recovery, the price trend being in general upward. In the utility group Electric Bond & Share, American Gas & Electric, Associated Gas & Electric A, Niagara Hudson Power and United Gas Improvement participated in the rally. A mixture of gains and losses occurred mid-week, when the utility group became the center of attraction.

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Holding Company Extends Interests Abroad

PUBLIC UTILITY HOLDING CORPORATION of America and the Deutsche Bank of Berlin have arranged to purchase jointly a 50 per cent interest in the equity of the Westphalia United Electric Power Corporation of Germany, up to the present time a government-owned utility. The other 50 per cent interest will be owned by the Province of Westphalia and a group of German municipalities. The Deutsche Bank and Harris-Forbes interests have been closely affiliated in respect to various German projects for several years. Public Utility Holding Corporation has also become a large minority stockholder of L'Union Electrique Rurale.

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April Customer-Ownership Sales Increase $6,000,000

REPORTS SHOW AN INCREASE of nearly $6,000,000 in April sales of stock to customers, employees and other local parties over those of the preceding month, and again, as in March, almost triple sales as compared with the same month last year. On the basis of monthly reports received by the ELECTRICAL WORLD it is estimated that sales during the month amounted to $21,400,000, the number of shares sold was 470,000, and the number of transactions 36,850.

This method of financing has increased steadily since the beginning of the year, with January sales $9,412,000, February $13,000,000 and March $15,500,000.

The number of shares sold during April was probably the largest ever sold in any one month. The only recorded exception came in May, 1928, but that month's total is known to have included a large amount exchanged for an issue of an earlier date. The value of stock sold during the month did not, however, break any records, an exceptionally large number of shares being of the low-priced variety. Thus, in the $25 class one company sold 65 per cent of the total number, over 300,000 shares, and received for them about $7,700,000, which is only 36 per cent of the entire value of the month's sales.

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Electric Power & Light Increases Stock

STOCKHOLDERS OF THE Electric Power & Light Corporation on June 24 increased the total authorized capital stock from 4,020,000 shares to 7,020,000 shares without par value, the latter divided into 800,000 shares of $7 preferred stock, 1,000,000 shares of $6 preferred stock, 1,000,000 shares of $5 preferred stock, 120,000 shares of second preferred stock, series A, 100,000 shares of second preferred stock, series AA, and 4,000,000 shares of common.

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Trade Commission Seeks Cause of Foshay Failure

By K. K. HOYT

Of ELECTRICAL WORLD'S *Washington Office*

HEARINGS on the W. B. Foshay Company, recently concluded before the Federal Trade Commission, present a clear analysis of a discredited type of utility financing. That the Foshay methods ended in bankruptcy of this particular utility holding firm is only half the story. Beyond that, it is probable but unfortunate that such a spectacular failure has tended to cast doubt into many minds as to the integrity of all utility finance. In its heyday the firm had its great tower building, its car card assurances of "no loss to any investor" and its swollen earnings statements, all of which stockholders saw as concrete evidence of stability. Afterward it was shown how the writing up of property values and intangibles was employed to indicate profits instead of losses on the company books. The practices of the Foshay company were evidently a travesty on methods properly employed by other and sounder enterprises in the utility field.

The W. B. Foshay Company was incorporated in 1917 both in Minnesota and Delaware. Its plan was to buy utility properties wherever they could be found on the North American continent and, to sell them to its subsidiary, Public Utility Consolidated Corporation (Delaware and Arizona), at a profit. That was the theory. Practically speaking, few properties changed hands during the latter part of the operating period. According to the testimony presented the Foshay company would gain an option and would contract to deliver to Public Utility Consolidated Corporation. Without waiting for delivery, Public Utility Consolidated Corporation would make payment to the Foshay company through its own stock, not at the purchase price of the property contracted, but at a higher appraisal. Then the Foshay company would try to market this stock through its many sales offices. Failing to sell enough securities, it found its liabilities pyramiding. This and the practice of issuing dividends and salary bonuses out of capital finally led to voluntary receivership.

More than twenty electric companies were included in the system. What-

ever their individual soundness, operation was open to the disadvantage of wide separation. The subsidiaries were scattered through ten states from Washington to Georgia and included holdings in Ontario and Quebec, Alaska, Mexico, Nicaragua and Honduras. They were said to serve 244 communities, with a total population of 331,000. Total generating capacity is given as 25,700 kva., including 9,700 kva. hydro. Many single turbines of other large systems exceed the Foshay total. The group owned 1,078 miles of transmission lines. It owned gas generating capacity of 1,635,000 cu.ft. per day with 99 miles of distributing mains. There also were water, telephone and ice properties. Some heating service was sold. Gross operating revenues are given as $1,660,000 in 1928 and $2,696,000 in 1929, with percentage distribution as follows: Electricity, 49.6 per cent; gas, 6.1; water, 13.5; ice, 10.5; telephone, 7.7; miscellaneous, 12.6.

The big Foshay Tower Building in Minneapolis, with a book value of $4,409,000, was involved in the financial difficulties, but is held apart from the utility properties.

Management methods employed

Subsidiary power and holding companies had no individual liabilities, their obligations being held entirely by Public Utility Consolidated Corporation. Except where state laws prevented, Public Utility Consolidated Corporation operated the properties. In cases where the laws prevented an out-of-state or foreign corporation from operating a local utility, as in California, Illinois, Vermont, Honduras, etc., a title to the local property was conveyed to an operating company formed within the state to satisfy the law. Such subsidiary companies would not be caused to issue any bonded debt of their own and so Public Utility Consolidated Corporation is the only company in the operating system having bonded debt outstanding. There is one exception of a recently acquired company which presumably would have been put on the same basis had not bankruptcy intervened.

Management and supervision services were furnished by the Foshay company under contracts with Public Utility Consolidated Corporation and with thirteen of the subsidiary power companies. A central engineering, accounting and legal staff was employed. Payment was on the basis of no charge for the first six months, ½ per cent for the next six months and advancing to 2½ per cent after 36 months.

So far the story is of a scattered but apparently bona fide system of utilities. Now let us view the financial structure, which was superimposed.

The principal business of the W. B. Foshay Company apparently was stock selling, handled through offices in 30 cities. Some miscellaneous sales were made by brokers, but the Foshay securities were not listed on any of the stock exchanges. Public support was encouraged through widespread advertising of a sensational type. The firm also maintained a publicity office, sending releases through the nation which resulted, it was claimed, in a large volume of "free advertising." An associated firm, called the Investors National Company, aided in the financing by buying securities for cash from the Foshay company. Foshay employees and stockholders held the securities.

Foshay Tower in Minneapolis also involved in bankruptcy

These efforts resulted, between 1927 and 1929, in sales to the public of $29,000,000 in securities of the Foshay company and its affiliates. The liabilities of the Foshay company alone amount to $19,000,000.

In order to embark in activities beyond the utility business, the W. B. Foshay Company was organized under the corporate laws of Minnesota with powers broad enough to cover virtually any lawful kind of business. Reorganization was made under a Delaware company of the same name and identity.

Public Utility Consolidated Corporation had been organized in Delaware to hold and operate the Foshay utilities. Since Delaware has no blue-sky or corporation commission of a type to approve securities in satisfaction of Minnesota law, it was necessary for Minnesota authorities to investigate and report on the proposed issue. The report was unfavorable. It was stated at the Federal Trade Commission hearing that resultant savings by consolidation of the operating properties will be small because their wide separation makes economical joint operation difficult; the values of the properties and stock turned over to Public Utility Consolidated Corporation are not sufficient to support the proposed capitalization; earnings do not justify it, and the holding company is further handicapped by having an unusually large number of notes and bond and stock discount, a large portion of which would require charging off during the first year's operation. For these and other reasons, the commission opined that the sale of Public Utility Consolidated Corporation securities would "work a fraud on the purchasers thereof."

To sidestep this difficulty, Public Utility Consolidated Corporation was reorganized under Arizona laws. Approval by the Arizona commission automatically permitted the sale of securities in many other states, including Minnesota, without investigation by the agencies of those states.

Purchasing methods used

Once organized in Arizona, the corporation was able to use the approval of various stock issues as a basis for sales in other states. That the firm was under the eye of a state commission was considered by the brokers to be a good selling point. Its obligations were in bonds, 7 per cent preferred stocks, class A common and class B common stock. The latter held sole voting power and were retained by the Foshay group. The preferred stocks had voting power contingent upon dividend failure, but regular payments were made up to receivership.

As soon as the Foshay company secured an option on a property and contracted for its delivery to Public Utility Consolidated Corporation, the latter would have an independent engineering firm make an appraisal which would turn out to be above purchase price. Then the Arizona commission would be asked to approve a stock issue on this appraised value. In dealing with the California commission, a disallowance of $778,900 was made on a property originally carried on the books at $2,329,600. The disallowance appeared on the balance sheet as an asset, nevertheless.

In the usual case, as soon as the Arizona commission had approved a security issue, the stocks would be delivered to Foshay in return for a contract to deliver the property concerned. At the time of receivership, the Foshay company had received securities to the value of $7,000,000 in return for properties which it had not delivered and could not deliver through inability to sell the stocks and secure funds.

Throughout the history of the Foshay

group it appears numerous write-ups were used to cover unprofitable transactions. The principal appreciation which occurred with Public Utility Consolidated Corporation was after the California disallowance mentioned above. This reduced the value by about one-third to $1,550,000, until a going concern value was added to the extent of $1,430,000, a write-up of 92.6 per cent. Other going concern items are buried in subsidiary records in the group. Of interest is the accounting method used when Peoples' Light & Power Corporation, organized by the W. B. Foshay Company, was sold in 1927 to Ohrstrom & Company prior to the formation of Public Utility Consolidated Corporation. A net loss was incurred. The transaction was said to have been represented by the company as profitable.

In order to cover various losses, the Foshay company applied a write-up of $1,500,000 on the class B stock of Public Utility Consolidated Corporation. Though never realized through sale of stock, this appreciation was distributed through the balance sheets of the Foshay company. A sum of $441,000, representing book profits on undelivered property, likewise was added. This meant that while the Foshay company showed a total net income or profit of $1,692,000 available for dividends, there was an actual loss of $226,000.

Nevertheless, unbroken dividend installments were maintained up to receivership to a total of $1,105,000. Not only that, but the six principal officers are reputed to have received large salaries and supplementary bonuses for their services. The total salaries during the life of the firm made up $1,204,000, of which it is said Mr. Foshay received $690,000. The officers and directors voted themselves $479,000 as a bonus plus income tax thereon. Dividends were $101,000 the month before the company went bankrupt.

These are some, but not all, of the reasons why the investigators believe the Foshay properties became insolvent. Most of the data here presented are from the testimony of Frank Buckingham and E. R. Lucas of the commission's staff. No representatives of the company or its receivers were at the hearings.

It is quite clearly shown that the troubles in the Foshay system were due to the group in control and do not reflect on utility management at large. Incidentally, the W. B. Foshay Company once had a membership in the National Electric Light Association, but "found it undesirable to continue it."

NEWS BRIEFS

Commonwealth & Southern Corporation has announced the establishment of a branch office in Birmingham, Ala., with headquarters in the office building of the Alabama Power Company, a subsidiary company.

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United Gas Improvement Company has increased its directorate from fourteen to sixteen members, Clarence H. Geist and Edward Hopkinson, Jr., being the new members elected.

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Harris-Forbes interests have been accorded further representation on the board of the Associated Gas & Electric Company with the election of W. E. McGregor of Boston to the directorate and to the finance committee of the utility system. Mr. McGregor is one of the senior vice-presidents of Harris, Forbes and Company.

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New Financing Totals $745,452,100 in 1930

JUNE brought to a close the six-month period with a total of $745,452,100 recorded for new utility financing. This figure compares with $583,400,000 for the six months ended June 30, 1929, an increase of 27.8 per cent.

The volume of the new offerings rather than the number of companies participating accounted for the substantial sum of $187,344,600 for the month of June, as against $65,544,500 for June a year ago and $102,700,000 for the preceding month, May.

Attention is called to the prominent part taken by preferred stock issues in the month's activities. The average rate of return yielded the investor touched the 5.28 per cent mark, as compared with 5.43 in May. This trend has been downward in recent months.

NEW SECURITY ISSUES OF ELECTRIC SERVICE COMPANIES IN JUNE

Name of Company	Amount	Period (Years)	Class	Purpose	Interest Rate	Price	Per Cent Yield
Electric Bond & Share Co.	$18,300,000	...	Cumulative preferred stock	General corporate purposes	5	91½	5.45
Federal Public Service Corp.	1,000,000	17	First lien gold bonds	To provide funds for additions and extensions to be made, to reimburse for such expenditures already made and for other corporate purposes	6	94	6.60
Central Power & Light Co.	5,500,000	26	First mortgage gold bonds	To reimburse treasury for expenditures made for additions and improvements to properties and for other corporate purposes	5	95	5.35
Electric Power & Light Co.	10,050,000	...	Cumulative preferred stock	General corporate purposes	6	100½	5.95
Kansas Power & Light Co.	2,214,000	...	First mortgage gold bonds, series B	To reimburse for additions and extensions, refunding and for other corporate purposes	5	96	5.27
Middle West Utilities Co.	50,000,000	1–5	Convertible gold notes	To develop subsidiary companies and for general corporate purposes	4½–5	100–97.31	4.50–5.62
New England Public Service Co.	5,490,000	...	Prior lien preferred stock	To increase company's investment in the junior securities of subsidiaries, to retire short time debt and for other corporate purposes	6	91½	6.55
United Power & Light Corp. (Kan.)	1,500,000	17	First mortgage gold bonds, series B	To reimburse corporation for additions and extensions to its properties and for other corporate purposes	5	96½	5.30
American & Foreign Power	24,625,000	...	Cumulative preferred stock	General corporate purposes	6	98½	6.09
Central Arizona Light & Power Co.	7,500,000	30	First mortgage gold bonds	To retire funded debt now outstanding, to reimburse company for expenditures made for additions to property and for other corporate purposes	5	96½	5.24
Queens Borough Gas & Electric Co.	1,000,000	...	Cumulative preferred stock	Additions, extensions and improvements	6	105	5.71
Philadelphia Co.	9,950,000	...	Cumulative preferred stock	To invest in subsidiary companies and for other corporate purposes	6	99½	6.03
Cities Service Co.	43,115,600*	20	Convertible gold debentures	Construction expenditures, additional investments, additions to properties and to reimburse for such expenditures	5	100	5
Central Illinois Public Service Co.	3,100,000	38	First mortgage gold bonds series G	To reimburse for extensions and additions	5	97½	5.15
Western Power, Light & Tel. Co.	4,000,000	1	Gold notes	Additions	5½	99.67	6

Total ..... $187,344,600.
Total amount actually realized, $177,146,188

Rights $45,000,000
Total financing for June, $222,146,188

*Original offering $118,115,600, of which $45,000,000 was subscribed for by common stockholders and $30,000,000 by members of underwriting syndicate.

Business News and Markets

General Electric Seeks to Stabilize Employment

IN AN effort to cope with the serious problem of unemployment, President Gerard Swope of the General Electric Company recently announced a combined plan to stabilize employment and to provide financial assistance for the unemployed. Funds for the latter purpose will be contributed on an equal basis by employees and by the company.

The unemployment plan may be adopted by any works, regardless of the action of the other plants, and the company will participate upon the affirmative vote of 60 per cent or more of the eligible employees of that works. Any employee with continuous service with the company of one year or more is eligible for membership. By enrolling, the participant agrees to pay into a trust fund created by the plan approximately 1 per cent of his actual weekly or monthly earnings for a period of three years, but only so long as his earnings are 50 per cent or more of his average full-time weekly or monthly earnings.

In case of abnormal times of unemployment, normal contributions by participating employees would cease and all employees who are subject to lay-offs would aid themselves as much as possible, and when they could no longer do this, then those employees who are still working would contribute toward the aid of the men who are laid off, while the General Electric Company would itself contribute in both instances to an equal extent to that of the participating employees.

According to the plan, up to 3 per cent of the contributions paid into the trust will be available for the relief of employees or former employees in need; up to 27 per cent of the normal contributions will be available for loans to employees who are members, and the balance, approximately 70 per cent of the normal, together with all emergency contributions and all interest on the funds, will be available for unemployment payments.

The trust which will handle the funds will be in charge of a board of trustees and the General Electric Company will guarantee 5 per cent interest. The company will also pay the administration expenses for the first two years.

Local autonomy in works

The plan will operate separately in each works, and its administration in each works will be vested in a board of not less than four or more than sixteen members, one-half of whom will be elected by the participating members and the other half appointed by the General Electric Company. No payments will be made from the fund for at least six months after its creation, and thereafter only to employees who have made normal payments for at least six months. Payments to contributing employees who receive notice of a temporary lay-off shall be 50 per cent of their average earnings for full time, but in no case more than $20 per week, and such payments shall not exceed ten weeks in any twelve consecutive months. When an employee is working part time and receiving less than 50 per cent of his average full-time wage he may be eligible for payments amounting to the difference between the amount he is receiving as wages and the maximum he might be entitled to under the unemployment plan.

Should an unemployment emergency arise at any particular works, when payments from the fund are 100 per cent or more of the average normal receipts, then all employees of this works, whether participants in the plan or not, and including the highest officers of the company connected with the particular works, will be called upon to contribute approximately 1 per cent of weekly or monthly earnings. Also, in such an emergency, all the general and district commercial men, general manufacturing, engineering and administrative employees of the company at all works and offices in the United States

When Business Is Increasing

1. Increase the working force by adding employees as slowly as possible.
2. Increase the number in especially busy departments by transfers from other departments.
3. Resort to overtime in particular departments and generally before increasing the working force.
4. Postpone plant renewal and maintenance work as much as possible, employing the men on regular production.

When Work Begins to Fall Off

1. Cease hiring at once.
2. Cut out all possible overtime and bring departments down to the normal week.
3. Transfer people from slack to busier departments.
4. Stimulate the sales department to secure co-operation from customers and get business for future delivery.
5. Build standard apparatus for stock up to (*) months' shipments, based on average of last three years' sales, adjusted to expectation of next two years.
6. See that stocks at all factory and district warehouses are brought up to this maximum.
7. Use men on maintenance and repair work, bringing the plant and equipment up to a high standard.
8. Cut the normal week as generally and gradually as possible, by departments (down to 50 per cent of the normal week).
9. Proceed with construction of increased plant facilities previously planned, using our own men as far as possible.
10. Drop new employees with less than one year of service—single people with no dependents and who are most easily spared first—always with not less than one week's notice.
11. In accordance with our custom established for some time, employees should be told whether it is a temporary lay-off, due to lack of work, or permanent lay-off, and in every instance of permanent lay-off the usual compensation, if any, should be paid, depending upon character of work, age and length of service.

**Varies.*

not on a particular works payroll shall contribute their proportion to the fund. This proportion shall be determined by the ratio of the average earnings of the contributing employees of the particular works to the total payroll of the eligible employees of all works of the company. The General Electric Company will contribute dollar for dollar to all such moneys added to the fund. After the emergency is over, normal payments to the fund by participants will be renewed.

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Tariff Policy Should Govern Size of Our Surplus

DEALING WITH THE PLACE of America's surpluses in the scheme of world economics, Owen D. Young, chairman of the board of the General Electric Company, told the Public Policy Session of the National Electric Light Association at the recent convention that "our surpluses are a kind of governor of our economic engine—either they blow off at the appropriate time or the engine blows up. The idleness of men who wish to work is the most dangerous surplus which can exist in any country. Its paralyzing blight reaches not into our economics alone, but goes much further. It is ridiculous to speak of unemployment as a necessary condition of human society. It is nothing more than a maladjustment of its machinery. When our political policy in international affairs becomes co-operative in spirit, when our economic policy looks to the economic development of the world as a whole and the improvement of living standards and consuming power of peoples everywhere, when our tariff and our treaties are made to evidence this spirit, then we may hope for effective plans for farm relief, for reduction of our surplus of raw materials and manufactured goods, for relief of unemployment, and for, what is most important of all, a better spirit of all nations toward us and toward each other."

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General Electric Has 88,383 Stockholders

THE GENERAL ELECTRIC COMPANY has 88,383 stockholders, an increase of approximately 60 per cent in the past year, according to figures released by the company at Schenectady. The count was made on June 20, the record date for dividends to be paid in July. In June, 1929, the number of stockholders totaled 55,216.

The accompanying tabulation for the last five years gives the number of stockholders at the four annual periods when counts were made for dividend payments.

	1926	1927	1928	1929	1930
March	37,422	44,969	49,740	53,985	†72,847
June	*38,853	47,384	49,572	55,216	88,383
September	44,226	48,867	50,448	56,383	.....
December	46,305	49,841	51,882	60,374	.....

*Change of each share of $100 par value common stock into four shares of no par value common stock, effective May 26, 1926.

†Change of each share of no par value common stock into four shares of no par value common stock, effective January 24, 1930.

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Westinghouse Forms New Spanish Connection

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY announces that through its subsidiary, the Westinghouse Electric International Company, it has joined with a group of Spanish financial and industrial leaders in the formation of a new company, known as Constructora Nacional Maquinaria Electrica, capitalized at 12,000,000 pesetas, to manufacture electric generators, motors, transformers, and other electrical apparatus in Spain.

Arrangements have been made whereby the new company will collaborate with both the Westinghouse Electric International Company and Le Material Electrique S-W, the French company formed recently by Schneider-Crousot and Westinghouse interests. These arrangements secure for the Spanish company engineering, manufacturing, and research information, the granting of exclusive patent rights for Spain, and the technical guidance of the Westinghouse company.

The new company will be a national Spanish industrial enterprise in every respect. Seventy-five per cent of its stock has been subscribed for by a Spanish group consisting of Banco de Bilboa, Sociedad Espanola de Construccion Naval and Sociedad Espanola de Construcciones Electric Mecanicas. The remaining 25 per cent has been taken by its French and American associated companies.

The new company has taken over the electrical business of the Electro Mecanicas organization (which, however, retains its extensive copper interests) and has acquired from "Naval" an existing plant in Cordoba and ground on which to build a factory in Reinosa.

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TRADE BRIEFS

American Transformer Company of Newark, N. J., announces expansion of its line of electric resistance welding machines. E. P. Larkin, a pioneer and authority in welding applications, is now associated with the company in charge of the expansion program. Improvement in design, with the purpose of eradicating present serious defects in machines and increasing the efficiency of welding operations, will be the policy.

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Bryant Electric Company has appointed William J. Weaver, formerly northeastern district sales manager, general sales manager.

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Nehring Electrical Works, manufacturer of weatherproof wires and cables, De Kalb, Ill., announces that contracts have been placed for complete equipment for the manufacture of bare copper wire and cable.

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Bristol Company, Waterbury, Conn., manufacturer of safety hollow set screws and socket head cap screws, has been granted a manufacturing and selling license by the Dardelet Threadlock Corporation under its patents for self-locking screw threads.

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Announcement has been made by the H. K. Ferguson Company, engineer and builder at Cleveland, that it has acquired the business, assets and good will of Warren D. Spengler, Inc., consulting power plant engineer of Cleveland. This is the second nationally known engineering organization which has joined the H. K. Ferguson Company within the last two months, the first being the De Vore Engineering Company of Toledo, specialist in the design and layout of glass plants and paper mills.

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Titan Electric Company, with headquarters at Adrian, Mich., has been recently reorganized, recapitalized and incorporated. The company manufactures fractional-horsepower electric motors, generators, electric grinders, buffers and electric pump jacks.

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Ohio Brass Company announces the appointment of M. M. Kenneally to the position of sales manager of the power utilities department. Mr. Kenneally was formerly connected with the New York office of the Ohio Brass organization.

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New York Metal Prices

	June 25, 1930 Cents per Pound	July 2, 1930 Cents per Pound
Copper, electrolytic	12	11⅞
Lead, Am. S. & R. price	5½	5½
Antimony	7	7
Nickel, ingot	35	35
Zinc, spots	4.225	4⅛
Tin, straits	31⅛	30⅛
Aluminum, 99 per cent.	24.30	23.30

Market Conditions

GENERAL condition of business continues quiet, only meager sales being executed in the various sections of the country. On the Pacific Coast there was a further decrease, but power company business predominated. In the East the demand for electrical equipment declined, especially in the field of heavy machinery, though substation apparatus was sought.

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PACIFIC COAST

—WHOLESALERS REPORT that June *business showed a further decrease under May and that the half year shows a decrease under 1929 that shades up from south to north, registering about 10 per cent for southern California, 5 per cent decrease for northern California, while Portland shows a 5 per cent increase over 1929. Seattle shows about 7½ per cent decrease.*

—THE RADIO AND MUSIC ASSOCIATION *is holding a Pacific Coast convention in San Francisco and the attendance is a third higher than ever before, caused by the prospects of stabilizing the industry and the introduction of new models.*

Power company business predominates in the local market, with such orders as a $20,000 General Electric switchboard equipment for the Tiger Creek development. A $7,500 General Electric switchboard for the Salt Springs plant, and Westinghouse distribution transformer orders aggregating $30,000 from southern California, which is in the market for $250,000 worth of distribution transformers. The outstanding inquiry of the week covers 31,000 ft. of 750,000-circ.mil three-conductor, 11,000-volt sector cable for San Francisco, worth about $70,000. Other interesting industrial orders cover a $40,000 Westinghouse auxiliary navigation equipment for a shipbuilding company of San Francisco, a $3,000 switchboard, and supply equipment for a Honolulu sugar plantation, a bid covering yearly requirements for the city of San Francisco, two carloads of 60-ft. poles, 9-in. top, for Redding, and prospective equipment amounting to $5,000,000 for two plants, one being for the Ford company at Richmond and the other for Shell Oil by-products at Martinez. Gas wars and unsettled gas distribution conditions have, however, caused several companies to discontinue all expansion activities with the consequent cancellation of orders for floodlighting projectors, reflectors and wiring material. Other interesting orders reported cover $2,000 worth of wiring and other supplies for an irrigation district, municipal lamp contracts for San Francisco, Fresno, and Oakland, aggregating $40,000, a $38,000 electrical contract for a San Francisco school, and a $1,250,000 general contract for the United States Marine Hospital in San Francisco, $14,000 worth of Westinghouse ranges for Seattle, a $6,000 lighting contract for an airport, a $5,000 contract for an electric pier in Oakland, and an automatic telephone system costing $11,000 for the United States naval ammunition depot at Hawthorne, Nev. Considerable new major construction is announced, including such items as a $2,000,000 club and hotel in San Francisco, the $350,000 Crocker residence for Hillsborough, the Lloyd Hotel for Portland, the $1,000,000 Hotpoint range plant for Ontario, a $1,000,000 Hollywood medical-dental building, and a $750,000 shopping mart for Long Beach.

Following abandonment of the plan for a steam auxiliary plant in the industrial district, the Seattle municipal lighting department is writing specifications for apparatus, including boilers, oil circuit breakers, transformers, switching equipment, etc., for a projected addition to Lake Union steam auxiliary. The cost, including building and apparatus, will exceed $500,000 and work, it is stated, will be completed this summer. The largest single motor order announced last week involved about $4,000 worth of machines for the Olympic Forest Products pulp mill in Port Angeles, Wash. Other sales reported include 25 motors from 50 hp. down to dealers, industrials and irrigation, 30 from 40 hp. down to dealers, refrigeration plant, sawmill machinery manufacturers and woodworking plants and several small motor-generator sets for navy yard and a theater.

CONSTRUCTION PROJECTS

Edison Electric Appliance Company, Ontario, Calif., plans plant addition to cost $1,000,000. Shell Chemical Company, San Francisco, Calif., plans plant at Pittsburg, Calif., to cost over $3,000,000. Ford Motor Company, Dearborn, Mich., is taking bids for an assembling plant at Richmond, Calif., to cost over $1,000,000. Crown-Zellerbach Company and San Francisco *Chronicle*, San Francisco, Calif., plan hydro-electric power plant and paper mill in Alaska to cost over $10,000,000. Los Angeles and Montebello, Calif., plan ornamental lighting systems. Mountain States Power Company, Tacoma, Wash., plans transmission line from Diamond Lake to Newport, Wash.

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SOUTHWEST

—THE GENERAL CONDITION *of business in electrical lines continues quiet. Manufacturers report that after two years of slack fan business the demand during the past two weeks has been the best on record.*

There have been some good shipments of insulators and pole line hardware. Contracts closed are for a lot of 40 motors for a new cotton gin in Arkansas amounting to $7,000 and a 300-kw. generator for connection to Diesel engine with exciter set valued at $4,000. An order for well over $1,000,000 has been placed with the Westinghouse Electric & Manufacturing Company by the Union Electric Light & Power Company of St. Louis, Mo., for electrical equipment.

CONSTRUCTION PROJECTS

Kansas City Power & Light Company, Kansas City, Mo., has filed plans for a power substation to cost $50,000. Anchor Lithographing Company, St. Louis, Mo., has plans for plant to cost about $200,000. Chelsea, Okla., plans extensions and improvements in municipal power plant, including installation of additional equipment. Paragould, Ark., is planning municipal electric power plant to cost $120,000. Central Power & Light Company, San Antonio, Tex., contemplates power plant near Corpus Christie, Tex., to cost over $650,000. Texas Power & Light Company, Dallas, Tex., has plans for power plant addition at Trinidad, Tex., to cost over $300,000.

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SOUTHEAST

—BUSINESS IN THE SOUTHEAST *during the past week presented somewhat of a paradox, in that dealers in all classes of material report a more optimistic tone among the customers than has existed within the past 60 days, but on the other hand no news of note in the way of sales or inquiries was forthcoming, except in a few instances.*

A utility company in Florida purchased generators and turbines valued at $196,000 and condensers at $29,000. An oil company operating in Florida purchased motors and generators to the amount of $13,000. An Alabama steel company purchased repair parts to the amount of $13,000. A Georgia construction company purchased cable to the amount of $8,000. Another Georgia

construction company purchased switchboards to the amount of $5,100 and a 10-ton hoist at $2,200. A Georgia utility company purchased meters to the amount of $3,200; instruments $1,300; line, hardware, and poles to the amount of $5,000; motors $1,600, and wire, $19,000. Manufacturers of copper products report a tendency on the part of the market to await lower prices, and therefore report business unusually quiet in their line. Collections are reported as normal, and the general belief appears to be that some improvement in business conditions is near.

CONSTRUCTION PROJECTS

University of Virginia, University, Va., plans addition to power plant to cost $150,000. Fairmont, W. Va., contemplates installation of airport lighting system. Monroe, La., contemplates installation of a municipal electric power plant, reported to cost over $75,000. Fort Pierce Growers Association, Fort Pierce, Fla., contemplates fruit packing plant to cost over $300,000. Florida Power Corporation, St. Petersburg, Fla., contemplates power plant at Arran and extensions in transmission lines to cost over $100,000.

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MIDDLE WEST

—GENERAL BUSINESS IN THE MIDDLE WEST *section continues much the same this week. There has not been sufficient evidence to indicate any definite improvement, but it is quite generally felt that this week will end the period of readjustment and better business may be expected from now on. While no decided improvement is looked for until fall, general business is thought to be on the up-grade. The demand for major apparatus has been somewhat limited, but a better demand is noted for distribution equipment.*

Some of the interesting orders placed this week include three 500-kw. battery-charging motor-generator sets, twelve 600-amp. and twelve 3,000-amp. single-pole, single-throw, 15-kv. disconnect switches and several construction orders aggregating $100,000.

CONSTRUCTION PROJECTS

Stanley, Wis., has authorized a fund for an ornamental street-lighting system. Motor Wheel Corporation, Lansing, Mich., plans plant to cost $200,000. Michigan Paper Company, Plainwell, Mich., will carry out expansion program, including addition to power plant to cost $350,000. Wisconsin Steel Works, Chicago, Ill., has plans for an addition to cost $185,000. Notre Dame University, South Bend, Ind., plans engineering building to cost $450,000. Fairmont Railway Motors, Inc., Fairmont, Minn., plans addition to cost $140,000. John Deere Plow Company, Moline, Ill., will build factory branch and distributing plant at Sioux City, Iowa, to cost $150,000. Quaker Petroleum Company, Omaha, Neb., plans compounding and distributing plant to cost $150,000.

EASTERN

—THE TURN OF JULY *shows a decline in orders for electrical equipment in the Eastern district; commitments now being made are for immediate requirements and advance business is in the minority.*

—MANUFACTURERS CONTINUE TO REPORT *a good volume of inquiries both from central stations and industrial interests, but time of maturity of purchases is decidedly indefinite. Heavy machinery is securing only casual interest, and substation apparatus, motors and control equipment represent the bulk of demand. Municipal power station account is holding up well.*

A northern New York central station has placed an order with a state manufacturer for regulators to cost $30,000. A New Jersey power company has contracted with a New York maker for gas boosters and switchgear to an amount of $40,000. A Pennsylvania manufacturer will furnish a 10,000-kw. turbo-generator unit with accessories for a municipal power station in Iowa. A city in Tennessee has placed orders for boilers, coal-handling machinery and auxiliary equipment for a municipal power plant, following recent awards for prime mover and other electrical apparatus. A central station in Ohio has ordered a quantity of transformers from a New York manufacturer, totaling $140,000.

Industrial account seems to offer equal promise with central station business according to present trend of activity. Expansion programs by large industrials are responsible for a sizable volume of inquiries in the New York district. Iron and steel mills will expend more than $75,000,000 for work of this kind during the remainder of the year. Chemical plant expansion will total more than $20,000,000 in that same period. A manufacturer of pumping machinery at New York has placed an order for motors with a state maker, costing $30,000. A manufacturer of motors, blowers and kindred equipment for industrial installations reports business as very quiet, with little encouragement in immediate outlook. A New Jersey manufacturer of electrical instruments says that companies are purchasing only as may be absolutely necessary; sales are considerably below normal for this time of year and prospects for the next 60 days show no change in this condition.

Electric equipment account in the Philadelphia district is on a lower basis than at any time since the first of the year. Orders are light and inquiries show a tendency to mark time for an indefinite period. Metal plants are among the best prospects in the industrial field; motors and controls are in fair demand in that quarter. Textile business is dull. Export demand, while spotty, is recording some sizable business. A manufacturer of electric cranes in New York has secured an order for ten units for installation in Chile.

CONSTRUCTION PROJECTS

Continental Can Company, New York, plans plant at Camden, N. J., to cost about $1,000,000. General Electric Company, Schenectady, N. Y., plans factory and distributing plant at Minneapolis, Minn., to cost about $450,000. Board of Education, New York, will receive bids on general contract until July 8 for Brooklyn Technical High School to cost $5,600,000. Shell Eastern Petroleum Products, Inc., New York, plans power plant at oil works at Sewaren, N. J. Trenton, N. J., plans electrification of municipal pumping station. RCA-Victor Company, Camden, N. J., is carrying out expansion program at radio equipment and talking machine plants to cost over $300,000. Pittsburgh Plate Glass Company, Pittsburgh, Pa., has plans for a factory at Milwaukee, Wis., to cost $1,000,000. General Purchasing Officer, Panama Canal, Washington, D. C., will receive bids until July 14 for Diesel engines (Panama Schedule 2566.)

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NEW ENGLAND

—BUSINESS CONDITIONS ARE SPOTTY *in New England. General scheduled materials are moving well. Small lot orders for industrial equipment and central station supplies are encouraging.*

Motor orders exceeding $30,000 have been received. Central station equipment orders include several interesting insulator sales totaling over $5,000 and new substation equipment of approximately $12,000. Pole line material, crossarms and wire shipments are steady and in good volume and to date are ahead of last year. Electric specialties are demanding attention. Floodlighting units amounting to more than $3,000 were recently sold by one company for playground and landing field. Illumination electrical recording meters for control of industrial operations show steady sales in this district.

Electric clock sales are reported to be more than double the volume for last year, according to one manufacturer. Less demand for electric heating furnaces is reported, though manufacturers are receiving inquiries for future installations. Merchandising continues to show an encouraging trend and little let-down in sales is reported.

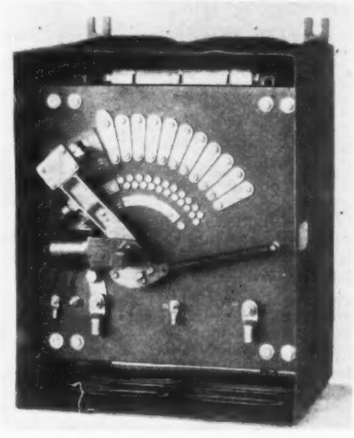
CONSTRUCTION PROJECTS

Springfield, Mass., has plans for a municipal repair and equipment plant to cost $100,000. Holyoke, Mass., contemplates a vocational training school to cost $125,000. United Illuminating Company, New Haven, Conn., has filed plans for an addition to power plant at Bridgeport, Conn., to cost $300,000.

New Equipment Available

Rheostats Regulate Speed of Shunt Motors

THREE DIRECT-CURRENT SPEED-REGULATING rheostats for starting and regulating the speed of shunt or compound-wound, direct-current motors in non-reversing service have been announced by the Westinghouse Electric & Manufacturing Company. Class 7350 is for a 50 per cent speed reduction through armature control and 25 per cent increase by field control. Class 7310 is for a 50 per cent speed reduction through armature control, and class 7210 is for use where an increase up to four times full speed through field control is desirable.



With all these types of rheostats the motor is started by moving the rheostat handle to the right. The contact arm is provided with a spring, which returns to the "off" position in case of voltage failure. This affords low-voltage protection and eliminates the possibility of the motor starting without all of the resistors in the circuit.

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Cable Suspension Clamps Permit Heavier Lines

FOR ATTACHING SUPPORTING MESSENGERS to wood poles where lead-covered cables weighing 12 lb. or more to the foot are used in transmission and distribution circuits the Malleable Iron Fittings Company, Branford, Conn., offers several heavy-duty clamps which are new developments in its line.

The new type PA170C assembly is designed for heavy duty to support messengers for either straight runs or turns, permitting heavier aerial cable runs than were heretofore considered practical in aerial cable service.

Type PA175E clamp is suitable for supporting lighter cable weighing from 8 to 12 lb. per foot. PA192 is an improved design for 6 to 8-lb. construction. Both of the latter clamps embody the desirable features of the heavier one and, it is claimed, offer improvements over previous designs.

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A WEATHERPROOF SWITCH HOUSE, as part of its line of outdoor station equipment, is announced by the General Electric Company. The construction of the house and the arrangement of the panel and devices afford maximum rigidity and accessibility of all live parts. These switch houses are available for manual or automatic operation on three-phase, three- or four-wire circuits of 2,300 to 15,000 volts, 5 to 1,200 amp.

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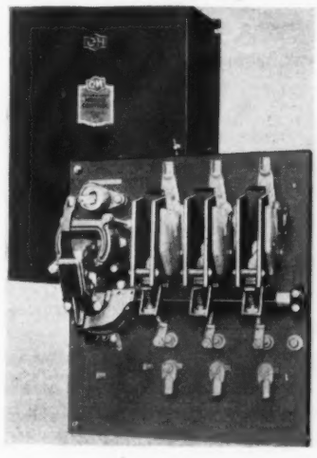
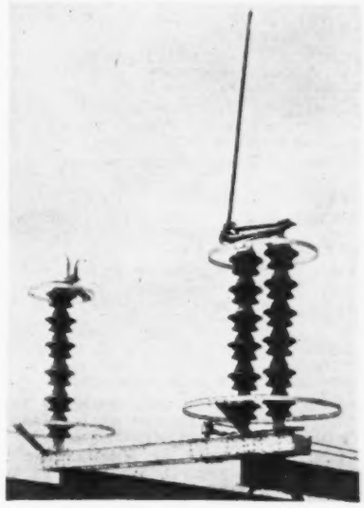
Magnetic Contactors for Heavy Duty Service

TWO NEW MAGNETIC CONTACTORS for heavy-duty a.c. service which are rated for maximum capacities of 300 and 600 amp. are announced by Cutler-Hammer, Inc. Features of these new contactors make them generally applicable to all heavy-duty requirements. They are arranged for either two- or three-wire control, have continuous duty operating coils, highly efficient magnet structure and exceptionally heavy, butt type, solid copper contacts. An air cushion absorbs the shock of the magnet on closing.



220-Kv. Disconnect Switch with Balanced Blade

A NEW STYLE OF 220-kv., high-pressure contact disconnecting switch with a self-contained blade-balancing mechanism of non-ferrous parts and also self-cleaning contacts has been announced by the Railway & Industrial Engineering Company, Greensburg, Pa. This type switch has recently been installed in Canada, California and New Jersey by its manufacturers.



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Material Insulates Vibration and Sound

A RESILIENT, RUBBERLIKE MATERIAL held between coarsely woven jute cloth or burlap is being offered for vibration insulation purposes by the International Products Corporation, Milwaukee, Wis., under the trade name "Keldur." It tends to deaden noise and check vibration, but is not subject to deterioration in the presence of oil and will not harden, according to the manufacturer. It possesses durability against mechanical and chemical disturbances and will retain its elasticity almost indefinitely. The initial compression varies between 1 and 6 per cent.

The material can be used for either light or heavy equipment mountings, such as drop hammers, for motors and generators, presses, transmission equipment, prime movers and all kinds of machinery where noise and vibration are to be held at a minimum. In certain applications, like electrically driven household refrigerators, "Keldur" is used for soundproofing purposes. It can also be used as a soundproofing material for doors and walls and as a floor covering over concrete.

Directory of Electrical Associations

AMERICAN ASSOCIATION OF ENGINEERS. Secretary, M. E. McIver, 8 South Michigan Ave., Chicago, Ill.

AMERICAN ELECTRIC RAILWAY ASSOCIATION. General secretary, Guy C. Hecker, 292 Madison Ave., New York City.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, Colin G. Fink, Columbia University, New York City.

AMERICAN ENGINEERING COUNCIL. Executive secretary, L. W. Wallace, 26 Jackson Place, Washington, D. C.

AMERICAN INSTITUTE OF CONSULTING ENGINEERS, INC. Secretary, P. W. Henry, 75 West St., New York City.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. National secretary, F. L. Hutchinson, 33 West 39th St., New York City. Board of directors meets bi-monthly. Sections and branches meet monthly in the principal electrical centers throughout the country. Three national and several district conventions held each year.

AMERICAN SOCIETY FOR TESTING MATERIALS. Secretary-treasurer, C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Secretary, C. W. Rice, 29 West 39th St., New York.

AMERICAN STANDARDS ASSOCIATION. Secretary P. G. Agnew, 29 West 39th St., New York City.

AMERICAN WELDING SOCIETY. Secretary, M. M. Kelly, 29 West 39th St., New York.

ARIZONA UTILITIES ASSOCIATION. Executive secretary, J. S. Arnold, Central Arizona Light & Power Co., Phoenix, Ariz.

ARKANSAS UTILITIES ASSOCIATION. Secretary-treasurer, R. I. Brown, Arkansas Power & Light Co., Little Rock, Ark.

ARTISTIC LIGHTING EQUIPMENT ASSOCIATION. Managing director, C. L. Benjamin, 711 Graybar Bldg., 420 Lexington Ave., New York City.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, Preston S. Millar, 80th St. and East End Ave., New York.

ASSOCIATION OF ELECTRAGISTS INTERNATIONAL. Secretary, Laurence W. Davis, 420 Lexington Ave., New York City, N. Y. Direct membership and membership through chartered local chapters throughout the United States and Canada.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. Managing director, John F. Kelly, Empire Bldg., Pittsburgh, Pa.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS. Secretary-treasurer, Joseph A. Andreucetti, Room 411, C. & N. W. Terminal Station, Chicago, Ill.

CANADIAN ELECTRICAL ASSOCIATION (affiliated with N.E.L.A.). Secretary, H. M. Lyster, 407 Power Bldg., Montreal.

COLORADO UTILITIES ASSOCIATION. Secretary-treasurer, O. A. Weller, Public Service Co. of Colorado, Denver, Colo.

EAST CENTRAL GEOGRAPHIC DIVISION, N.E.L.A. Secretary, D. L. Gaskill, 603 Broadway, Greenville, Ohio.

EASTERN GEOGRAPHIC DIVISION, N.E.L.A. Secretary-treasurer, Harold A. Buch, Telegraph Building, Harrisburg, Pa. Managing director, A. B. Millar.

ELECTRIC ASSOCIATION (THE) (Chicago). Manager, Ralph S. Steffens, 20 North Wacker Drive, Chicago, Ill.

ELECTRICAL ASSOCIATION OF NEW YORK, INC. Secretary, John L. Owen, 250 Fourth Avenue, New York.

ELECTRICAL LEAGUE OF COLORADO. Manager, George Bakewell, Jr., Gas & Electric Bldg., Denver, Colo.

ELECTRICAL LEAGUE OF UTAH. Executive secretary, R. E. Folland, Newhouse Hotel, Salt Lake City, Utah.

EMPIRE STATE GAS AND ELECTRIC ASSOCIATION. Secretary, Charles H. B. Chapin, Grand Central Terminal, New York City.

FLORIDA ENGINEERING SOCIETY. Secretary, W. W. Fineren, Gainesville, Fla.

GEORGIA ELECTRICAL ASSOCIATION. Secretary-treasurer, J. J. McDonough, Georgia Power Co., Dublin, Ga.

GREAT LAKES GEOGRAPHIC DIVISION, N.E.L.A. Secretary-treasurer. T. C. Polk, 20 North Wacker Drive, Chicago.

ILLINOIS STATE ELECTRIC ASSOCIATION. Secretary-treasurer, George W. Schwaner, 205 Illinois Mine Workers' Bldg., Springfield, Ill.

ILLUMINATING ENGINEERING SOCIETY. General secretary, E. H. Hobbie, 29 West 39th St., New York City.

ILLUMINATING GLASSWARE GUILD. Assistant business manager, C. H. Ferris, Stevenson Corp., 19 West 44th St., New York City.

INDIANA ELECTRIC LIGHT ASSOCIATION. Secretary, Vera Cox, 1548 Consolidated Building, Indianapolis, Ind.

INSTITUTE OF RADIO ENGINEERS. Secretary, Harold P. Westman, 33 West 39th St., New York City.

INTERNATIONAL ASSOCIATION OF ELECTRICAL INSPECTORS. Victor H. Tousley, 612 North Michigan Ave., Chicago. Eastern, Western, Southwestern, Northwestern and Southern Sections.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, H. N. Lang, P. O. Box 1864, Orlando, Fla.

INTERNATIONAL ELECTROTECHNICAL COMMISSION (international body formed of 26 national electrotechnical committees). General secretary, C. le Maistre, 28 Victoria St., Westminster, London, S. W., England.

IOWA SECTION, N.E.L.A. Secretary and treasurer, H. E. Weeks, Davenport, Iowa.

KANSAS SECTION, N.E.L.A. Secretary, Mrs. Lillian M. Jacoby, Kansas Gas & Electric Co., Wichita, Kan.

KENTUCKY ASSOCIATION OF PUBLIC UTILITIES. Secretary, E. F. Kelley, Louisville Railway Company, Louisville, Ky.

MARYLAND UTILITIES ASSOCIATION. Secretary, D. E. Kinnear, United Railways & Electric Co. of Baltimore, 803 Court Square Bldg., Baltimore, Md.

MICHIGAN ELECTRIC LIGHT ASSOCIATION. Secretary, Herbert Silvester, 401 South Street, Ann Arbor, Mich.

MIDDLE WEST GEOGRAPHIC DIVISION, N.E.L.A. Secretary-treasurer, Thorne Browne, 1527 Sharp Bldg., Lincoln, Neb.

MISSOURI ASSOCIATION OF PUBLIC UTILITIES. Secretary, F. D. Beardslee, 315 North 12th St., St. Louis, Mo.

NATIONAL ASSOCIATION OF RAILROAD AND UTILITIES COMMISSIONERS. Secretary, James B. Walker, 270 Madison Ave., New York.

NATIONAL COMMITTEE ON THE RELATION OF ELECTRICITY TO AGRICULTURE. Director, E. A. White, 1120 Garland Bldg., Chicago.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Managing director, Paul S. Clapp, 420 Lexington Avenue, New York City.

NATIONAL ELECTRICAL CREDIT ASSOCIATION. Secretary, Frederic P. Vose, 1008 Marquette Building, Chicago, Ill. Central, New England, New York and Middle and Southern Atlantic States Divisions.

NATIONAL ELECTRICAL MANUFACTURERS' ASSOCIATION (consolidation of Associated Manufacturers of Electrical Supplies, Electric Power Club and Electrical Manufacturers' Council), Managing director, A. W. Berresford, 420 Lexington Ave., New York City.

NATIONAL ELECTRICAL WHOLESALERS' ASSOCIATION. Managing director, E. Donald Tolles, 165 Broadway, New York City. Pacific Coast Division: Secretary, Albert H. Elliot, 502 Flatiron Bldg., San Francisco.

NATIONAL FIRE PROTECTION ASSOCIATION Chairman of electrical committee, A. R. Small, 109 Leonard St., New York City.

NATIONAL SAFETY COUNCIL. Managing director and secretary, W. H. Cameron, Civic Opera Building, 20 North Wacker Drive, Chicago, Ill.

NEBRASKA SECTION, N.E.L.A. Secretary-treasurer, Thorne Browne, 1527 Sharp Building, Lincoln, Neb.

NEW ENGLAND GEOGRAPHIC DIVISION, N.E.L.A. Secretary, Miss O. A. Bursiel, Statler Building, 20 Providence St., Boston, Mass.

NEW MEXICO UTILITIES ASSOCIATION. Secretary-treasurer, Bernard L. Wiles, Albuquerque, N. M.

NEW YORK ELECTRICAL SOCIETY. Secretary, Frederic M. Delano, 29 West 39th St., New York City.

NORTH CENTRAL ELECTRIC ASSOCIATION (Geographic Division N.E.L.A.). Secretary-manager, J. W. Lapham, 803 Plymouth Bldg., Minneapolis, Minn.

NORTHWEST ELECTRIC LIGHT AND POWER ASSOCIATION (Geographic Division N.E.L.A.). Secretary, Berkeley Snow, 1206 Spalding Building, Portland, Ore.

OKLAHOMA UTILITIES ASSOCIATION. Manager, E. F. McKay, 1020 Petroleum Building, Oklahoma City, Okla.

PACIFIC COAST ELECTRICAL ASSOCIATION (Geographic Division N.E.L.A.). Secretary, Samuel H. Taylor, Suite 729-730, 447 Sutter St., San Francisco, Cal.

PENNSYLVANIA ELECTRIC ASSOCIATION. Managing director, A. B. Millar; secretary-treasurer, Harold A. Buch, Telegraph Bldg., Harrisburg, Pa.

PUBLIC UTILITIES ASSOCIATION OF VIRGINIA. President, C. B. Short, Roanoke Railway & Electric Co., Roanoke, Va.

PUBLIC UTILITIES ASSOCIATION OF WEST VIRGINIA. Secretary, A. Bliss McCrum, P.O. box 1483, Charleston, W. Va.

ROCKY MOUNTAIN GEOGRAPHIC DIVISION, N.E.L.A. Secretary, O. A. Weller, Public Service Co. of Colorado, Denver, Col.

SOCIETY FOR ELECTRICAL DEVELOPMENT, INC.. Acting President, Charles L. Edgar; chairman executive committee, C. L. Edgar; secretary-treasurer, J. Smieton, Jr., 420 Lexington Ave., New York. Annual meeting second Friday in September; directors' meetings second Friday in March, June, September and December; executive committee meetings every thirty days.

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